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TRAUMATIC DENTAL INJURIES AND OBESITY

AMONG

12-YEAR-OLD SCHOOL CHILDREN

By
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Supervisor
Dr. Lamis Darwish Rajab, Prof

This Thesis was Submitted in Partial Fullfillment of the Requirements for the Master's Degree of Science in Pediatric Dentistry

Faculty of Graduate Studies
The University of Jordan

تعتمد كلية الدراسات العليا
هذه النسخة من الرسالــة
التوقيع.........التاريخ.........

August, 2011

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COMMITTEE DECISION

This Thesis (Traumatic dental Injuries and obesity among 12-year-old school children) was successfully defended and approved on 3rd July /2011

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تعتمد كلية الدراسات العليا
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التوقيع........التاريخ ٢٨/٨/٢٠١١

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DEDICATION

For A Name I Am Proud To Have & A Great Man Always Beside

To My Dear Father…

For A Loving Heart…To My Sister..My Best friend..My Soul mate

To My Precious Mother…

To My Brothers & Sisters;

For All the Joyful Moments They Brought to My Life..

A Family I am Lucky to Have..

To My Biggest Family..Relatives & Friends;

For A Small Pure World Around…

And to YOU

Because You Made My Life..

Tala, 2011

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LIST OF ABBREVIATIONS OR SYMBOLS

ACRONYM	**DESCRIPTION**
AAPD	American Academy of Pediatric Dentistry
ADHS	Attention-Deficit Hyperactivity Syndrome
ASD	Academy for Sports Dentistry
BMI	Body Mass Index
CDC	Centers for Disease Control and Prevention
cm	Centimeter
IOTF	International Obesity Task Force
Kg	Kilogram
m	Meter
NCHS	National Center for Health Statistics
NHANES	National Health and Nutritional Examination Survey
SES	Socio Economic Status
TDI	Traumatic Dental Injury
UNRWA	United Nations Relief and Work Agency
WHO	World Health Organization

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TRAUMATIC DENTAL INJURIES AND OBESITY AMONG 12-YEAR OLD SCHOLL CHILDREN

By
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ABSTRACT

Background: Traumatic dental injuries (TDIs) are unexpected common events especially in childhood. The long term consequences, the costs of treatment, its effect on esthetics, phonetics, and function make TDIs a serious public dental health problem.

Aims of the study: This study aims at evaluating the prevalence of traumatic dental injuries to the permanent anterior teeth and determining their associated factors among Jordanian schoolchildren aged 12 years, and investigating possible significant association between TDIs and obesity.

Methods: A cross-sectional population-based study examined and interviewed a total of 1025 schoolchildren attending 34 schools randomly selected from urban and rural areas of Amman-the capital city of Jordan. A two-stage cluster random sampling technique was used. The prevalence and the pattern of TDIs were studied in relation to obesity, gender, socioeconomic indicators, type of injury, treatment provided and treatment needed, details of the injury event, in addition to overjet size and lip coverage. The epidemiological classification adapted by WHO and modified by Andreasen et al. was used to classify TDIs. Overweight and obesity were defined according to the international cut-off points of body mass index for boys and girls between 2 and 20 years old. Chi-square test and stepwise logistic regression model were used for statistical analysis; the level of significance for all tests was set at 0.05.

Results: The prevalence of TDIs was 16.3%, the most common type of dental trauma was fracture of enamel (65%), followed by enamel and dentin fracture (20%).only 6.4%

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of injured teeth received treatment. Upper central incisors were the most involved teeth in dental trauma (92.7%), and boys presented more traumatic dental injuries than girls (OR=1.424, CI; 1.007-2.014, $P<0.05$)). The relationship between TDIs and obesity was not statistically significant ($P>0.05$). Children with increased overjet beyond 3 mm presented with more TDIs than other children (OR=1.215, CI; 0.859-1.718). Results of multiple logistic regression confirmed that TDIs were significantly more prevalent among boys, and children with inadequate lip coverage (OR=1.947, C.I.; 1.348-2.812, $P< 0.05$).

Conclusions: The prevalence of TDIs to permanent anterior teeth among 12-year-old schoolchildren living in Amman was high compared with other studies. However, treatment of TDIs is still neglected. Being a male with inadequate lip was associated with higher probability of having a TDI. Obesity had no significant effect on the occurrence of TDIs. Moreover; TDIs were more prevalent in underweight children.

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Chapter one: Introduction

1.1 Background

Oral health is an integral part of general health. Growth and development of children are affected by oral diseases through pain and tooth loss, a condition that affects the appearance, quality of life, and nutritional intake (World Health Organization, 2003). Oral diseases are broad to include dental caries, periodontal disease, oral cancers, traumatic dental injuries (TDIs), noma, dental erosion and dental flurosis (Petersen, 2005).

The treatment and prevention of dental caries has traditionally been the main concern of pediatric dentistry (WHO, 2003). With decreasing prevalence of caries in some communities, TDIs have evolved into an important global oral health burden among children (Grimm, et al., 2004, Sgan-Cohen, et al., 2005).

The distribution and severity of oral diseases vary in different parts of the world and within the same country or region. Unlike dental caries and periodontal disease, reliable data on frequency and severity of TDIs are still lacking in most countries, particularly in developing countries (Petersen, 2005). However, TDIs are on the increase. Prevalence of 11-17 percent have recently been reported among 12-year-old schoolchildren in the Middle East (Livny, et al., 2010, Noori and Al-Obaidi, 2009), where in certain industrialized countries the prevalence of TDIs ranges from 4 to 33 percent among 12 to 14 year old children (Andreasen and Andreasen, 2002).

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TDIs are unexpected common events which can take place at any age causing an irreversible dental loss with inconvenient consequences to the child and parents. This is due to the long term follow-up and the risk of possible complications that can occur even after years post treatment.

The economic costs of treatment, its impact on the oral health-related quality of life and the possibility of prevention, have made TDIs a serious public dental health problem in children (Glendor, et al., 2007). Approximately 40 percent of children have their first contact with the dentist due to a TDI (Lygidakis, 1998).

Oral factors (increased overjet with protrusion, incompetent lips), environmental determinant (material deprivation) and human behavior (risk-taking children, children being bullied, emotionally stressful conditions, obesity and attention-deficit hyperactivity disorder) were found to increase the risk for TDIs (Glendor, 2009).

Many oral health problems are preventable. However, there is still a lack of knowledge among children, their parents and teachers on the causes and prevention of oral disease (Rajab, et al., 2002). New oral health goals are urgently needed to address significant components of TDIs and strengthen the knowledge of mothers, teachers, and children about the causative factors, the value of prevention, and immediate management (Al-Jundi, 2006). These global strategies will assist regions, countries and policy makers to develop preventive programmes that are targeted at populations and high risk groups, and to further improve the quality of oral health systems (WHO, 2003).

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Obesity is another major public health problem in both developed (James, et al., 2001) and developing countries (Khader, et al., 2009). Prevalence of obesity differs from one country to another, and differs by gender, age, and social class (Wabitsch, 2000). It is an excess amount of body fat in proportion to lean body mass, to the extent that health is impaired (Aronne and Segal, 2002). It is a risk factor for coronary heart diseases (Rashid, et al., 2003) and it is strongly associated with diabetes and hypertension (Green, 2005), other health problems (Lievense, et al., 2002), decreased life expectancy (Peeters, et al., 2003), impaired quality of life (Han, et al., 1998), and high costs (Wolf, 1998).

Obesity affects oral health through the potentially negative effects that it may have on the periodontium (Ritche, 2007). In addition, recent studies have identified an association between dental caries and obesity, suggesting that obese children are at higher risk for dental caries (Tuomi, 1989, Marshal, et al., 2007).

Thinking of obesity as a medical condition with serious co morbidities, full assessment is essential before engaging in any form of anesthesia (Ritche, 2007). An ongoing research is investigating if obesity is an oral bacterial disease, since several findings support the hypothesis that oral bacteria could be related to obesity (Goodson, et al., 2009).

The relationship between obesity and TDIs is still not clear. It has been considered a risk factor for dental trauma in only two studies (Nicolau, et al., 2001, Petti, et al., 1997), indicating that the overweight or obese schoolchildren presented a higher risk of dental trauma than the non-obese ones. While other studies found no statistically significant relationship between obesity and dental trauma (Soriano, et al., 2009, Ãrtun

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and Al-Azemi, 2005), highlighting a controversary in the literature that needs further investigations.

1.2 Hypotheses

1.2.1 Null hypothesis

There is no significant association between traumatic dental injuries and obesity among 12-year-old schoolchildren in Amman- the capital of Jordan.

1.2.2 Sub-hypotheses

1. There is no significant difference in the prevalence of TDIs between genders.
2. There is no significant difference in the prevalence of TDIs within different socioeconomic indicators, and between urban and rural areas.
3. Children who practice sports regularly have the same predisposing risk to TDIs as children with limited physical activities.
4. Children with increased overjet have the same predisposing risk to TDIs as children with normal overjet.
5. Children with inadequate lip coverage have the same predisposing risk to TDIs as children with adequate lip coverage.

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1.3 Aims and objectives of the study

This study aims to:

- Uncover any possible relationship between TDIs and obesity among 12-year-old schoolchildren in Amman-the capital of Jordan.
- Assess the prevalence of traumatic dental injuries to permanent anterior teeth among the studied population.
- Compare the prevalence of TDIs in both genders, and according to different socioeconomic indicators.
- Correlate TDIs with time, place, and cause of injury.
- Study the relationship between TDIs and orafacial predisposing factors like; overjet, and lip competence
- Assess types of TDIs in addition to treatment needed and treatment provided among the studied population.

1.4 Significance of the study

In Jordan, few epidemiological studies are available on TDIs to anterior permanent teeth among schoolchildren. Nevertheless; physical and psychological complications of TDIs can lead to relevant economic consequences to the health system.

Obesity is an important public health problem that affects children and adolescents in many countries, and has been pointed in the literature as a risk factor for TDIs.

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Worldwide, there are few studies correlating TDIs to anterior permanent teeth and obesity. This study will be the first in Jordan that explores the relationship between TDIs and obesity.

The study of predisposing and protective factors will help authorities and policy makers in the design of effective public preventive programs.

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Chapter Two: Literature Review

2.1 Traumatic dental injuries

"Any thermal, chemical or mechanical lesion that affects the dentition should be analyzed as a dental trauma and its effect, as a traumatic dental injury" (O'Brien, 1993).

Traumatic dental injury is a serious public health problem among children. Despite their relatively high prevalence, significant impact on individuals and society, and sound body of knowledge about its causative factors and treatment, TDIs are still neglected (Glendor, et al., 2007). The biological, socio-economic, psychological, and behavioral factors associated with dental trauma made it a challenge for oral health professionals (Lin, et al., 2008, Marcenes, et al., 2001, Nicolau, et al., 2003), since it constitutes a true dental emergency that requires immediate assessment and management (Ajlouni, et al., 2010).

2.1.1 Diagnostic classifications of traumatic dental injuries

Traumatic dental injuries have been assessed according to a wide variety of factors, such as etiology, anatomy, pathology, therapeutic considerations, and degree of severity, (Feliciano and Caldas, 2006). This wide range of existing classification systems in the literature; Ellis (1970), WHO (1978), Andreasen (1981), and Garcia-Godoy (1981), resulted in great differences regarding the prevalence and incidence figures of TDIs between countries and within various studies (Bastone, et al., 2000). Field screening is usually performed in epidemiological surveys, but without the use of some methods used in clinics, such as radiographic examination. The epidemiological

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classification-adopted by the WHO and modified by Andreasen et al.-reorganized the categories of TDIs according to the level of severity of the injury and the complexity of treatment required, and consequently made prevalence figures easily comparable between most studies (Glendor, et al., 2007). Nevertheless; evidence supports the fact that there is no suitable classification for establishing an accurate diagnosis which could be applied to epidemiological surveys (Feliciano and Caldas, 2006).

2.1.2 Epidemiology

There are few reports available on the epidemiology of injuries to the teeth of children when compared to epidemiological data on caries and periodontal diseases (WHO, 2003). However, a dramatic increase in dental trauma research has been observed in the last decades, emphasizing on the importance of TDI as a major public health problem (Andersson, 2010). Recently, Brazil and Turkey have been reported by the International Association of Dental Traumatology as the most productive countries in the research field, with India and China coming next (IADT, 2010). In Jordan, there are limited epidemiological data on the field of dental trauma.

2.1.2.1 Prevalence

The prevalence of TDIs is high worldwide (Glendor et al., 2007). Trauma to the oral region occurs frequently and makes up to 5 percent of all injuries for which people seek treatment in all dental clinics and hospitals in a country (Eilert-Petersson, et al., 1997). About one-third of all preschool children have suffered trauma involving the primary dentition and about a quarter have suffered trauma to the permanent dentition (Glendor,

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2008). However, while many studies have reported a high prevalence of TDIs to permanent anterior teeth (Cavalcanti, et al. 2009), other recent studies in South Africa and South India showed a low prevalence of 6.4 percent and 6 percent, respectively (Naido, et al., 2009, David, et al., 2009). According to recent population-based studies the prevalence of TDIs ranges from 4.1 to 58.6 percent (Glenor, 2008).

In the Middle East in a recent survey, the prevalence of TDIs was 17.7 percent among sixth grade school children in four Palestinian towns (Livney, et al., 2010), whereas other surveys among Jewish and Arab children in Jerusalem reported higher prevalence of TDIs, 29.6 percent and 33.8 percent, respectively (Sgan-Cohen, et al., 2005, Sgan-Cohen, et al., 2008). Lower levels were reported among similar age groups: 11.5 percent in Iraq (Noori and Al-Obaidi, 2009), 11.7 percent in Syria (Marcenes, et al., 1999), and 14.5 percent in Kuwait (Ărtun and Al-Azemi, 2009).

In Jordan, the first national survey identified a prevalence of 19.2 percent (Hamdan and Rock, 1995). In a more recent study, Rajab reported a prevalence of 14.2 percent among 7-15 year old children presenting at teaching clinics of the Department of Pediatric Dentistry between 1997 and 2000 (Rajab, 2003). Another study by Hamdan and Rajab (2003) reported a prevalence of 13.8 percent among 12-year-old schoolchildren in Amman. The percentage of TDIs among children seeking treatment for dental emergencies was 31 percent over a one year period in a dental teaching hospital in Irbid (Al-Jundi, 2002). However, in a recent study, Al-Ajlouni (2010) reported a lower prevalence of 9.89 percent among children referred to pediatric dental clinic from northern cities of Jordan.

Prevalence figures of TDIs in different regions of the world are presented in Table 1.

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Table 1. Prevalence figures of traumatic dental injuries in different regions of the world (modified from Glendor, 2008)

Region	Year	Age	Sample	Prevalence	Place of examination
Asia					
Thailand, Malkawi et al.	2005	11-13	2725	35.0	At school
South India, David et al.	2009	12	838	6.0	At school
South Africa					
Kwazulu, Naidoo et al.	2009	11-13	1665	6.4	At school
Europe					
U.K., Marcenes&Murray	2001	14	2242	23.7	At school
	2002	14	411	43.8	At school
Middle East					
Syria, Marcenes et al.	1999	9-12	1087	8.0	At school
Iraq, Noori and Al-Obaidi	2009	6-13	4015	6.1	At school
Israel, Sgan-Cohen et al.	2005	9-13	1195	29.6	At school
Jordan, Jamani and Fayyad	1991	7-12	3041	10.5	At school
Jordan, Hamdan and Rock	1995	10-12	459	19.2	At school
Jordan, Al-Jundi	2002	1.3-14	620	31	Pediatric clinic
Jordan, Rajab	2003	7-15	2757	14.2	Pediatric clinic
Jordan, Hamdan and Rajab	2003	12	1878	13.8	At school
Jordan, Al-Ajlouni	2010	6-14	3750	9.89	Pediatric clinic
Kuwait, Ărtun and Al-Azemi	2009	13-14	1583	14.5	At school
Palestine, Livny et al.	2010	11-12	804	17.7	At school
North America					
U.S.A, Shulman& Peterson	2004	6-50	15364	23.5	Dental clinic
Canada, Locker	2005	14	3010	18.5	Dental clinic
South America					
Brazil, Cortes et al.	2001	12	649	13.6	At school
Brazil, Marcenes et al.	2001	12	652	58.6	At school
Brazil, Nicolau et al.	2001	12	652	20.4	At school
Brazil, Traebert et al.	2003	13	307	18.9	At school
Brazil, Traebert et al.	2006	12	260	17.3	At school
Brazil, Soriano et al.	2007	12	1046	10.5	At school
Brazil, Cavalcanti, et al.	2009	7-12	448	21	At school

This variation in prevalence has been attributed not only to socio-economic, geographic, behavioral and cultural differences between study locations and countries, but also poor standardization of examination methods, study design and TDI classifications used (Glendor, et al., 2007).

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Using different methodologies has resulted in different prevalence figures, as well. It is inappropriate, for example, to compare figures found in clinic and hospital-based studies with population-based studies (Traebert, et al., 2003).

In most studies, prevalence figures were reported by sex, age, and socio-economic status.

2.1.2.1.1 Age

Most previous studies showed that the prevalence of TDIs increased with age, with the peak incidence of injury was among 11-12 years old children (Cavalcanti, et al., 2009, Rajab, 2003, Rocha and Cardoso, 2001, Saroglu and Sõnmenz, 2002, Zuhel, et al., 2005). However, the fact that the prevalence of dental injury increased with age doesn't mean that older children are more prone to injury, but the assessment of TDIs is cumulative (Soriano, et al., 2007). For example, in a previous study by Stewart et al. assessing pediatric dental injuries treated in hospital emergency department in the United States, ages were categorized into three groups : < 7, 7-12, and 13-17 years, corresponding to primary, mixed, and permanent dentition, respectively. The greatest number of dental injuries occurred among children one to two years of age and children < 7 years old accounted for 59.6 percent of injuries (Stewart, et al., 2009).

In some studies, the prevalence and incidence of TDIs were found to peak at 2-4 years of age and again at 8-10 years (Kahabuka, et al., 2001, Kargul, et al., 2003). The decrease in TDIs between the two peaks is accounted by the exfoliation of primary teeth and eruption of permanent teeth (Kahabuka, et al., 2001).

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In preschool children, TDIs tend to occur at young age during which growth and development take place (Glendor, et al., 2007). The figure is as high as 18percent of all injuries ((Eilert-Petersson, et al., 1997).

2.1.2.1.2 Sex distribution

Gender is one of the socio-behavioral factors reported in the literature to increase the risk for TDIs. Most studies reported that boys sustained injuries to the permanent dentition almost twice as often as girls. This difference by sex is mainly due to greater participation of boys in contact sports, fights and outdoor activities (Rajab 2003, Soriano, et al., 2004). Yet recent studies have shown a reduction in this gender difference, reflecting an increased interest in sports among girls (Altay and Güngör, 2001, Rocha and Cardoso, 2001, Traebert, et al., 2003). Traebert et al. (2006) claimed that the activities of a person and the environment are more determining factors of TDIs than gender, since girls can be exposed to the same TDI risk factors as boys. A trend toward more modern activities associated with computer games made children especially boys spend less time in sports and other outdoor activities than before (Traebert, et al., 2006). Marcenes et al. (1999) suggested that the behavioral and cultural diversity between countries has been responsible for the non-statistical significant difference in prevalence between boys and girls found in their study. In Jordan, one study reported no gender difference in northern Jordan (Al-Khateeb, et al., 2005).

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2.1.2.1.3 Socioeconomic status

In a recent literature review, few studies have investigated the correlation between TDIs in permanent teeth and socioeconomic indicators (Bendo, et al., 2009). The results were conflicting (Cortes, et al., 2001, Nicolau, et al., 2001, Marcenes, et al., 2001). Some authors reported a higher prevalence of TDIs among the highest socioeconomic groups (Grimm, et al., 2004), whereas others found that the lower socioeconomic groups were more prone to TDIs (Marcenes and Muray, 2000, Soriano, et al., 2001). In a study conducted in Brazil, (Marcenes et al., 2001), it was shown that children from mothers with higher schooling experienced more dental injuries than those from mothers with lower schooling, while father's level of education, parents' employment status and family income were not statistically significantly associated with dental injuries. In disagreement with previous studies, Fakhruddin et al. found no statistically significant association between TDIs and socioeconomic indicators (Fakhruddin, et al., 2008). In Jordan, the relationship between TDIs and socioeconomic indicators was not statistically significant (Hamdan and Rajab, 2003, Jamani and Fayyad, 1991)

Socioeconomic indicators vary between studies. Some used parents' level of education, mother's education level, family income and employment status, while others adopted the type of school and the social and physical environment of the school (Bendo, et al., 2009).

This variation resulted in no consensus in the literature regarding the association between the occurrences of traumatic injuries in permanent teeth and socioeconomic status, with the majority of studies analyzed found no such association (Fakhruddin, et al., 2008, Hamdan and Rajab, 2003, Marcenes, et al., 2001)

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2.1.2.1.4 Teeth involved

Most TDIs involve the anterior incisor teeth with maxillary incisors more affected than mandibular ones. Maxillary lateral incisors and mandibular central incisors were less frequently affected (Petti, et al. 1997, Marcenes, et al., 1999, Nicolau, et al., 2001, Hamdan and Rajab, 2003). This is explained by the non-rigid connection of the mandible to the cranial base dissipating the blows to the mandible, together with the low prevalence of Class III malocclusions (Stokes, et al. 1995). One single tooth is usually affected in each traumatic episode (Altay and Güngör, 2001, livny, et al., 2010, Hamdan and Rajab, 2003, Nicolau, et al., 2001, Marcenes, et al., 1999). However, traffic accidents and sports favor multiple tooth traumas (Ademyo, et al., 2005, Caldas, et al., 2008, Kumamoto and Maeda, 2005).

Since TDIs are more common in younger children (preschool age), primary teeth are usually more affected than the permanent ones (Eilert-Petersson, et al., 1997, Glendor, 2008). Children at these ages start learning to walk and lack coordination and skills which increase the risk of falling (Granville-Garcia, et al., 2006).

2.1.2.1.5 Details of the injury event

Few studies investigated the details of the injury event. Many studies reported that the majority of TDIs occurred at home followed by street or school (Rajab, 2003, Traebert, et al., 2006). In many reports most of the incidents occurred in summer (Kargul, et al., 2003), while others found that TDIs were more frequent in winter (Eilert-Petersson, et al., 1997).

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2.1.3 Etiology and risk factors

"Traumatic dental injury is not a disease but a consequence of several factors that accumulate throughout life if not properly treated" (Soriano, et al., 2009). Recently, the number of etiologies of TDIs has increased dramatically to include oral factors (e.g. overjet), environmental factors (e.g. material deprivation) and human behavior (e.g. risk taking), which are further separated into unintentional and intentional TDIs (Glendor, et al., 2009).

The causes of traumatic dental injuries are well known. Fall, collision with people or inanimate objects, traffic accidents, sports and violence have been reported as the most common causes of traumatic injuries to anterior permanent teeth (Cortes, et al., 2001, Marcenes, et al., 2001,Soriano, et al. 2004, Soriano, et al. 2007).

2.1.3.1 Oral predisposing factors

Increased overjet with protrusion and inadequate lip coverage have long been introduced as risk factors for TDIs (Marcenes, et al., 1999, Bauss, et al., 2004, Ărtun, et al., 2005, Sega-Cohen, et al., 2005, Traebert, et al., 2006, Soriano, et al., 2007). Shulman and Peterson reported that overjet was the only occlusal covariate significantly associated with maxillary incisor trauma, after adjusting for age, gender and race ethnicity (Shulman and Peterson, 2004). However, one study reported that anterior open bite increased the risk of TDIs in Brazilian preschool children younger than 5 years of age (Olieveira, et al., 2007).

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Previous studies proposed overjet > 3-3.5 mm as a risk factor ((Brin, et al., 2000, Borzabadi-Farahani, et al., 2010), others found > 5 mm has a more significance association with TDIs (Hamdan and Rajab, 2003). However, the argument in some studies that overjet with protrusion is combined with inadequate lip coverage (Ărtun, et al. 2005), which might act as a confounding factor. Moreover, Burden (1995) found that both increased overjet and inadequate lip coverage to the maxillary incisors were significant risk factors. However, lip coverage was the single most important independent predictor of TDIs. The same findings were reported by Brin et al. (2000). Nevertheless; in a more recent study in Iran, Borzabadi-Farhani et al. reported that lip competence was not associated with maxillary incisor trauma (Borzabadi-Farhani et al., 2010).

In their systemic review of the relationship between overjet size and TDIs, Nguyen et al. (1999) reported that age and gender confound the incisor-trauma relationship resulting in biased results. Other contradictory results were reported in the literature emphasizing the need for further research so that all factors are investigated at the same time (Marcenes, et al., 2000).

Few studies have investigated the association between facial forms and incisor trauma (Brin, et al., 2000, Borzabadi-Farahani, et al., 2010). In a clinical non-radiographic study, Borzabadi-Farahani et al. (2010) found that children with convex profile (Class II skeletal pattern), reduced Frankfort Mandibular Plane Angle (short faces), and increased overjet had a higher risk toward maxillary incisor trauma. Whereas Brin et al. (2000) proposed that dental and soft tissue cephalometric parameters are more important factors than skeletal relationships.

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2.1.3.2 Unintentional traumatic dental injuries

2.1.3.2.1 Falls, collisions

Falls, collisions, and being struck by an object were reported by most studies as the major causes of TDIs in preschool and school-aged children (Glendor, 2009).

2.1.3.2.2 Environmental determinants

Marcenes and Murray reported a high prevalence of 34-44 percent of TDIs in deprived areas in the United Kingdom, with overcrowding being the major environmental factor related to TDIs (Marcenes and Murray, 2000). This was explained by the unsafe playgrounds, sports facilities and other dangerous environmental conditions usually present in deprived areas, which facilitate falls and collisions (Glendor, 2009).

2.1.3.2.3 Human behavior

The Health Survey for England (1997) provided the initial data regarding the association between hyperactivity and major injuries affecting the face and/or the teeth. Lalloo reported that risk-taking children tend to have more dental trauma than non-risk-taking children (Lalloo, 2003). However, this was argued by other authors who found no such relationship (Odoi, et al. 2002). The environment might play a more important role than human behavior, suggesting that a safe environment would protect the child even if he or she is hyperactive (Traebert, et al., 2006).

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2.1.3.2.3.1 Emotionally stressful states

Children under emotional stress are more likely to sustain TDIs. Vanderas and Papagianolis reported a significant correlation of the incidence of TDIs with urinary epinpheine, so that as the value of epinephrine increased, the probability of TDI rose (Vanderas and Papagianolis, 2000). Adolescents who experienced adverse psychosocial environments along the life course were found to have more TDIs than those who experienced more favorable environments (Nicolau, et al., 2003).

Neurodevelopmental disorders may play an important role in the occurrence of TDIs among children (Lalloo, 2003, Odoi,et al., 2002, Sabuncuoglu, et al., 2005). The most common developmental psychiatric disorder is attention-deficit/hyperactivity disorder (ADHD), which is defined according to a specific set of symptoms-inattention, hyperactivity and impulsivity- as described in the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) (APA, 1994, CDC, 2007). Sabuncuoglu et al. proposed the first explanatory model for the relationship between TDIs and ADHD in a child psychiatric clinical population in Istanbul. Seven percent of children were reported to have a TDI with statistically significant association with ADHD (Sabuncuoglu et al., 2005).

2.1.3.2.4 Presence of illness, learning difficulties or physical limitations

Although many authors have reported TDIs in non-disabled individuals, few studies exist describing the prevalence of TDIs in children with special needs. Epilepsy, cerebral palsy (CP), hearing and visual impairment in addition to learning difficulties

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were the most common medical conditions reported in the literature to be associated with TDIs (Glendor, 2009).

A high prevalence (57%) was found in a group of individuals with cerebral palsy despite their restricted lifestyle (Holan, et al., 2005). A different pattern of injuries to the teeth in CP individuals relative to the known pattern in a healthy population was reported. Females were found to experience slightly more injuries than males do, due to similarities in life style between CP individuals in both genders (dos Santos and Souza, 2009, Holan, et al., 2005). However, dos Santos and Souza (2009) reported a lower prevalence (20%) for TDIs than that found by Holan et al. (2005), and found a significant association between CP type and TDIs presence, with diplegia presenting the highest percentage of trauma cases.

An interesting finding in CP subjects is that the relationship between TDIs and the size of overjet was not statistically significant (Holan, et al., 2005). Uncontrolled head movements, that are characteristic to individuals with CP, seemed to be a more important predisposing factor for TDI than occlusal characteristics and sport activities. Patients with learning difficulties have been found to experience a very high frequency of TDIs as well. This is due to the lack of motor co-ordination, crowded conditions in institutions, and concomitant epilepsy (Glendor, et al., 2007).

In a study investigating TDIs among Saudi Arabian children, Al-Sarheed et al. found that sensory impaired children had a tendency for more dental trauma and TDIs were more common among hearing-impaired children than visually impaired children. This was explained by the more restricted movement in visually impaired children (Al-Sarheed, et al., 2003).

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The literature still lacks data concerning TDIs in children with craniofacial anomalies. In a study carried out in Brazil, da Silva et al. demonstrated a high prevalence (53%) of oral trauma in less than 9-year-old children with bilateral clefts. The premaxilla was the most affected structure and soft tissue lesions were the most presented injuries. The anterior projection of the premaxilla, even after lip surgery, jeopardized children with bilateral clefts to higher risk of trauma due to the convex facial profile, especially during the first year of life (da Silva, et al., 2005). These findings emphasized on the importance of maxillary overjet as a risk factor for TDIs in healthy children.

2.1.3.2.5 Inappropriate use of teeth

Inappropriate use of teeth was investigated in few studies as an etiological factor for TDIs. Whereas Malikaew et al. (2006) reported a high prevalence of TDIs caused by inappropriate use of teeth, other studies resulted in lower figures (Nicolau, et al., 2001, Traebert, et al., 2003).

2.1.3.2.6 Iatrogenic injuries

TDIs through tracheal intubation are a rare but typical complication during general anesthesia (Vogel, et al., 2009), since anterior teeth are often used unintentionally for support during laryngoscopy (Hoffman, et al., 2005). Pre-existing dental pathology seemed to be a contributing risk factor for tooth injury during intubation (Vogel, et al., 2009). In a recent retrospective study, Vogel et al. (2009) found that the most common types of injury during intubation were crown fractures followed by dislocations, with

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the maxillary teeth primarily affected. Most cases in the study presented with one tooth injury and the left side of the maxilla was more affected than the right side.

Oral piercing has been recently introduced as another iatrogenic cause of TDIs. It was reported that the most common dental problem associated with piercing is chipping of teeth (De Moore, et al., 2000). In a recent study, Levin et al. (2005) found that tooth fracture and gingival recession appeared in 14-27 percent of patients with oral piercing.

2.1.3.2.7 Traffic accidents

Road accidents play a significant role in orofacial injuries. Some studies reported them as the first (Adeyemo, et al., 2005) or second (Newman, 1998) cause of maxillofacial fractures. In a review of all road accidents reports between 1998 and 2002 in Portugal, orofacial injuries were present in 15.6 percent of all road accidents, with the face being the second anatomical location sustaining the most severe injury. Soft oral tissue injuries were the most prevalent type among orofacial injuries followed by teeth and periodontal disease, with teeth fractures the most prevalent dental injuries (Caldas, et al., 2008).

2.1.3.2.8 Sports injuries

Sport is one of the main causes of TDIs. However, prevalence vary considerably depending on type of sport, selected group of athletes, geographic location, age of athletes, and the use of protective instruments (Glendor, 2009).

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Sport injuries account for 10-39% of all dental injuries. Children are most susceptible to sports-related oral injuries between the ages of 7 and 11 years (Newsome, et al., 2001). The majority affected the upper lip, maxilla and maxillary incisors, with 50-90% of dental injuries involving the maxillary incisors (Kumamoto and Maeda, 2005).

2.1.3.3 Intentional traumatic dental injuries

In the last years, physical child abuse has become a major concern of authorities and dental professionals since as many as 50–75 percent of all cases involved trauma to the orofacial region and more specifically the mouth (Cairns, et al., 2005). Children that are victims of physical violence may present intraoral injuries that range from mild injuries, like ecchymoses in the lips to more severe injuries, such as tooth crown fractures (Cavalcanti, 2010). In a study carried out by UNICEF Jordan on "Violence against Children in Jordan", it was reported that 50 percent of children were physically abused by family members and school teachers and administrators (Elayyan, 2007). As violence might be the cause of TDIs in children, dental professionals may play a significant role in notifying authorities responsible for children protection, and providing the best treatment possible for the victim (Welbury, 2007)..

2.1.3.4 Caries and traumatic dental injuries

Fakhruddin et al. reported a statistically significant association between a child caries experience and TDIs (Fakhruddin, et al., 2008). Locker noticed that children with TDIs had higher caries experience. It was suggested that a common risk-factor relationship

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between caries and trauma exist (Locker, 2005). However, in a more recent study (Ărtun and Al-Azemi, 2009) this hypothesis was rejected, claiming that the association between untreated caries and behaviors conductive to TDIs is unclear.

2.1.4 Consequences of traumatic dental injuries on children

Facial differences and dental malocclusion affect the self-esteem of children and young adults (Patel, et al. 2007). Children may experience anxiety produced by the unwanted attention of their peers and the inability to take part in school activities such as sports and music. TDIs can produce severe immediate unexpected pain as well as chronic pain (Nguyen, et al., 2004). Beside economic consequences of dental injuries, trauma results in quality-of-life insults that can lead to time off school and work, lost sleep and commuting for treatment (Wong and Kolokotsa, 2004).

In a study to assess the effects of severe dental injury on the quality-of-life (QoL) of children and parents, Berger et al. found that any dental injury severe enough to require intraoral splinting will have a clinically significant effect on the child and parents. All children in the study agreed that the injury was the most painful event, followed by emergency treatment and splint removal (Berger, et al., 2009). The authors also stated that beside the psychological trauma of seeing their child in pain, parents may feel guilty or may not have sufficient financial resources and time for multiple dental visits. Cortes et al. (2002) supported the hypothesis that children with untreated TDI of permanent teeth had more impacts on their daily living than children without any traumatic injury.

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2.1.5 Prevention of traumatic dental injuries

The American Academy of Pediatric Dentistry (AAPD) "recommends dentists in all specialties, including pediatric and general dentists, provide education to patients and parents regarding prevention of orofacial trauma as part of the anticipatory guidance discussed in dental visits" (AAPD, 2010). Knowledge of risk factors and etiology of TDIs is essential for developing and implementing effective prevention (Lin, et al., 2007). The public awareness of first-aid measures and the need to seek immediate treatment is important as well since this could improve the outcome of TDIs and prevent serious consequences in the future (Lin, et al., 2006, Pacheo, et al., 2003).

In a study carried out by Al-Jundi, the general knowledge of Jordanian mothers with regards to immediate management of TDIs was lacking regardless of their socioeconomic status, educational background, or previous encounter with TDI (Al-Jundi, 2006).

Orofacial sports-related injuries are unique from other type of injuries in that they are preventable. The AAPD encourages dentists to play an active role in educating the public on the importance of the use of protective equipments like hemlets, facemasks, and mouthgaurds for the prevention of orofacial injuries during sports. The Academy for Sports Dentistry (ASD) recommends the use of a properly fitted mouthguard that should be fabricated and provided by dental professionals. The cost-benefit of custom fabricated mouthguards is worth the investment when considering the fees and discomfort associated with a TDI and subsequent treatment (Ranalli, 2002). In its position statements, the ASD strongly supports and encourages the use of properly fitted mouthgaurds in all collision and contact sports (ASD, 2010). In a review of the

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literature, mouthgaurds have been regarded as an effective means for preventing or reducing severity of TDIs (Maeda, et al., 2009).However, efficacy of mouthguards for concussion prevention is still controversial. Scientific evidence utilizing randomized clinical trials is still needed to validate the efficacy of athletic mouthguards (CDC, 2001).

Considering obesity as one of the predisposing factors to TDIs, dentists can play a preventable role in the patients' well being by assessing nutritional status and encouraging healthy eating habits and physical life style (Granville-Garcia, et al., 2006).

Early orthodontic treatment of increased overjet to prevent incisor trauma has been recommended by many authors (Bauss, 2004, Brin, et al., 2000, Burden, 1995). Orthodontic treatment can change the facial profile configuration and consequently the objective risk of TDIs (Brin, et al., 2000).

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2.2 Obesity

2.2.1 Definition

According to the Centers for Disease Control and Prevention (CDC), obesity and overweight are both defined as "labels for ranges of weight that are greater than what is generally considered healthy for a given height, identifying ranges of weight that have been shown to increase the likelihood of health problem" (http://www.cdc.gov.com).

Obesity, a common metabolic and nutritional disorder, is a complex multifactorial chronic disease that develops from an interaction of genotype and the environment (Dennison, et al., 2007). Nicklas et al. (2005) defined obesity as a disease in which diet energy intake exceeds the body energy requirements resulting in excess body fat. In 1998, the World Health Organization declared obesity as a global epidemic.

2.2.2 Measurement

Methods of estimating body fat and body fat distribution include measurements of body mass index (BMI), skinfold thickness and waist circumference, calculation of waist-to-hip circumference ratios, and techniques such as ultrasound, computed tomography, and magnetic resonance imaging (MRI), (CDC, Himes, 2009).

2.2.2.1 Body Mass Index (BMI)

Body Mass Index (BMI), the Quetlet's index, has been considered the most common indicator used to assess overweight and obesity in a wide variety of settings, including clinical, public health, and community based programs (Himes, 2009). Although it is recommended by many international organizations as the most appropriate single

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indicator of overweight and obesity (Krebs, et al., 2007), it is certainly not a perfect surrogate for total body fatness and not without its technical limitations (Freedman, 2009).

It is derived from measurements of height and weight in the formula: weight (kg)/ height (m^2). These two anthropometric dimensions are the most commonly collected in children worldwide. Being noninvasive, relatively inexpensive, easily understood by health practitioners, the individuals being examined and their families, makes BMI the most widely accepted method used to screen for overweight and obesity (CDC, 2010).

2.2.2.2 Classifications

Defining overweight and obesity differs in adults from children and teens. Classifications of overweight and obesity for children and adolescents are age-and sex-specific because children's body composition varies as they age and varies between boys and girls (CDC, 2010). Whereas, overweight and obesity ranges for adults are determined by using weight and height to calculate the "body mass index" (BMI), as shown in Table 2.

Table 2. Body mass index categories for adults (adopted from Centers for Disease Control and Prevention).

BMI	Below 18.0	18.0 to 24.9	25.0 to 29.9	Above 30.0
Category	Underweight	Healthy weight	Overweight	Obese

For children and adolescents (aged 2–20 years), the BMI value is plotted on the CDC growth charts to determine the corresponding BMI-for-age percentile (Appendix I).

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As shown in Table 3:

- Overweight is defined as a BMI at or above the 85th percentile and lower than the 95th percentile.
- Obesity is defined as a BMI at or above the 95th percentile for children of the same age and sex.

Table 3. Current body mass index weight category guidelines (adopted from Centers for Disease Control and Prevention).

BMI percentile for age and sex	< 5^{th} percentile	5^{th}- < 85^{th} percentile	85^{th}- < 95^{th} percentile	>95^{th} percentile
Category	Underweight	Healthy weight	Overweight	Obese

2.2.3 Prevalence

The prevalence of obesity is increasing worldwide and is more evident in affluent societies and those undergoing modernization (International Obesity and Task Force (IOTF), 2005, WHO, 1998, WHO, 2003,). Environmental changes and life style promoting increased energy intake and decreased energy output have a widespread impact on children, facilitating the recent increases in the prevalence of overweight and obesity among American children (CDC, 2000). Ten Percent of the world's school children are estimated to be carrying excess body fat. Of these overweight children, a quarter is obese (Lobstein et al., 2004). In USA, middle school-age children are becoming the largest age group of all overweight and obese children, with rates having tripled in the last three decades (Hedley, et al., 2004). In the WHO European region, 20 percent of children and adolescents are overweight, and a third of these are obese. These

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findings are alarming, and contribute to the obesity epidemic in adults, creating a growing health challenge in the future (Branca, et al., 2007).

In Jordan, the overall prevalence of obesity was 49.7 percent in 1998 presenting the first data on the prevalence of obesity (Ajlouni et al., 1998), with females being more likely to be obese than males. In 2002, the Ministry of Health (MOH) with assistance from CDC and WHO, established the first behavioral risk factor surveillance program to monitor risk factors associated with chronic diseases, in which the self-reported diagnosed prevalence of obesity was 12.8 percent among adults aged 18 years or older. A second behavioral risk factor survey conducted in 2004 (CDC, 2006) indicated that the prevalence of obesity had increased by 53.2 percent in Jordan since 2002 (CDC, 2003). In a public health research to investigate obesity and diabetes in Jordan, the total prevalence of obesity based on measured weight and height was 34.8 percent compared to 22.8 percent self-reported obesity among adults aged 18 years or older (Zindah, et al., 2008).

The overall prevalence rates of overweight and obesity among Jordan University students were 28.5 percent and 10.2 percent, respectively (Suleiman, et al., 2009). Among schoolchildren aged 6-12 years old, 19.4 percent were overweight and 5.6 percent were obese in a study conducted in the north of Jordan (Khader, et al., 2009).

2.2.4 Etiology and risk Factors

The exact cause of pediatric obesity is not clear. Diet plays an important role in the obesity epidemic, since dietary habits have changed the last thirty years (Gidding,

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2006). Increasing trend of sedentary life style, spending too much time watching television or playing electronic games together with indulgence in consumption of junk food (rich in carbohydrates/fats and poor in fiber) are the main causes of obesity and overweight (Protcor, et al., 2003, Canning, et al., 2007).

With the epidemic explosion of overweight people, and the well-recognized inflammatory nature of obesity, the possible role of oral bacteria as a potential direct contributor to obesity had been investigated. This hypothesis is proposed by three mechanisms. First, the oral bacteria may contribute to increased metabolic efficiency. A second mechanism is that the oral bacteria could increase weight gain by increasing appetite. A third mechanism is that the oral bacteria redirect energy metabolism by facilitating insulin resistance through increasing levels of tumor necrosis factor-α or reducing levels of adiponectin. This condition of obesity arising from infection has been described as " infectobesity" (Goodson, et al., 2009). In a pilot study by Goodson et al. (2009), it was shown that the percentage of the bacterium S. noxia, obligate anaerobe found in both the mouth and the gastro-intestinal tract, was capable of identifying 98.4 percent of overweight women from a group of generally healthy persons. These findings suggest that S. Noxia may be an indicator of change in oral microbial ecology. However, it is not reasonable to suggest that oral bacterial infections have an etiologic role in obesity. Further investigations are still needed.

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2.2.5 Obesity and health consequences

Overweight and Obesity have long been associated with increased blood pressure (Must, et al., 1999). Compared with normal- weight individuals, obese persons have up to 5 times higher risk of hypertension, and up to 2/3 of cases of hypertension are attributed to excess weight (Wolf, et al., 1997). Obese persons have an about 1.5-fold increased risk for cardiovascular disease (including coronary heart disease and cerebrovascular disease), and between 10-15 percent of all cases of cardiovascular disease can be attributed to overweight and obesity (Wilson, et al., 2002). Obesity and type-2 diabetes are closely related as well. Obese persons have a more than 10-fold increased risk of developing type-2 diabetes compared with normal-weight persons (Field, et al., 2001).

The Metabolic Syndrome (MeS) is another example of obesity related diseases. It is a concept that encompasses metabolic abnormalities that co-occur to a greater degree than would be expected by chance alone, and which predispose individuals for a high risk to develop cardiovascular disease (Eckel, et al., 2005). The exact underlying cause of the metabolic syndrome is still unknown, However, recent definitions emphasize the focus on abdominal obesity as its core component (International Diabetes Federation, 2005).

2.2.5.1 Obesity and sedation in children

While some authors believe that childhood obesity and breathing sleeping disorders have no straightforward association (Kohler and van den dHuevel, 2008), others believe that obesity is a classic cause for alveolar hypoventilation and obstructive sleep apnea

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syndrome (OSA) (Lavie, et al., 2009), which is characterized by upper airway obstruction during sleep. Obese children may undergo respiratory difficulties during dental treatment under sedation as well, since obesity may impede the motion of the diaphragm especially in the supine position. This is of particular importance to pediatric dentists. Sedatives with minimal to none respiratory depression effect should be used in obese patients (Baker and Yagiela, 2006).

2.2.5.2 Obesity and oral health

2.2.5.2.1 Obesity and caries

Several investigators have noticed an association between dental caries and obesity in childhood, suggesting that obese children are at high risk for dental caries (Willerhausen, et al., 2004, Willerhausen, et al., 2007). It is unclear if there is a correlation between caries and obesity, or they just coexist since they have common etiologic factors such as diet and socioeconomic status (Alm, et al., 2008, Marshall, et al., 2007).

It is expected that obese children will have a higher prevalence of caries than normal or underweight children because of diet habits. High sugar intake is reported to be more common among overweight and obese children than those with normal weights. This eating pattern is a recognized risk factor for dental caries (Hong, et al., 2009). However, it is also claimed that children with severe caries have difficulty in eating resulting in being underweight (Marshall, et al., 2007). This was supported by Sheller et al. who found that a significant number of children with severe early childhood caries are underweight (Sheller, et al., 2009).

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In a recent review of the literature; no consistent findings between obesity and caries were reported (Table 4) (Bimstien and Katz, 2010). While some studies showed a significant association between caries frequency and weight (Alm, et al., 2008, Willerhausen, et al, 2007), others found that overweight children did not have an increased risk for dental caries after controlling for age, race and poverty (Kopycka-Kedziarawski, et al., 2008). Gerdin et al. (2008) found that the association between overweight and dental caries was weak. This correlates with a preliminary study in India which did not support an association between obesity and increase incidence of dental caries (Tripathi, et al., 2010). The same finding was reported by Sadeghi and Alizadeh who found no association between BMI-for-age and DFT indices among 6-11-year-old children in Isafahan, Iran. Moreover; the data from the Third National Health and Nutrition Examination Survey (NHANES III) suggested that being overweight may be associated with decreased rates of caries in older children.

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Table 4. Research studies on the association between obesity and caries prevalence (from Bimstien and Katz, 2010).

Author	Country	N	Age in years	Conclusions
Toumi (1989)	Finland	516	8-17	-Obesity itself was not a good predictor for dental decay. -Early obesity and caries experience may be used as predicting indicator of the true risk group.
Willerhausen et al. (2004)	Germany	842	6-11	-There is a relationship between an increase in dental caries and high weight.
Pinto et al. (2007)	USA	135	8-9	-No association between caries prevalence and obesity. Note: population with low caries rate.
Willerhausen et al. (2007a)	Germany	1290	6-10	-There is a significant association between caries frequency and weight.
Willerhausen et al. (2007b)	Germany	2071	6-10	-A significant association between BMI and caries persisted even after adjusting for age.
Granville-Garcia et al. (2008)	Brazil	2651	1-5	-No relationship was found between caries frequency and weight.
Alm et al. (2008)	Sweden	402	1-15	-Consumption of snacking products at early age may be associated with proximal caries at age 15 years.
Sheller et al. (2009)	USA	293	2-5	-Children with severe early childhood caries do not have a typical weight distribution. A significant number of children with severe early childhood caries are underweight.

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2.2.5.2.2 Obesity and periodontal disease

Obesity has been suggested as the strongest risk factor for inflammatory periodontal tissue destruction after smoking (Nishida, et al., 2005). Recent epidemiological studies had supported the hypothesis of obesity as a risk factor for periodontal disease and fat distribution pattern was found to play a crucial role in the association with periodontitis (Saito, et al., 2005, Al-Zahrani, et al., 2003, Wood, et al., 2003). Most of these studies were based on analysis of Japanese populations and United States data from the NHANES III.

The underlying biological mechanisms for the association of obesity with periodontitis are not well-known, however, adipose-tissue-derived cytokines and hormones may play a key role (Pischon, et al., 2007). Lundin et al. recently found a correlation between tumor necrosis factor-α in the gingival cervix fluid and body mass index. Adipose tissue serves as a reservoir for inflammatory cytokines, so it is possible that increasing body fat increases the likelihood of an active host inflammatory response in periodontal disease (Lundin, et al., 2004).

However, most studies investigating the relationship between periodontal disease and obesity have been cross-sectional (Table 5). Longitudinal studies with more precise measurements are still needed to provide better insights into this relationship (Saito and Shimazaki, 2007).

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Table 5. Studies on the relationship between obesity and periodontal disease.

Author	Country	N	Age in years	Conclusions
Nishimara et al. (2000)	US	79	30-40	BMI associated with periodontitis in non-insulin dependent diabetes mellitus patients.
Saito et al. (2001)	Japan	643	19-79	Waist-hip ratio, BMI, and body fat were associated with periodontitis.
Wood et al. (2003)	US	8842	30-49	Waist-hip ratio and BMI were associated with attachment loss nonlinearly.
Al-Zahrani et al. (2003)	US	13665	18-90	BMI $\geq$ 30 and high waist were associated with periodontitis especially in younger adults (18-34).
Saito et al. (2005)	Japan	584	40-79	BMI, Body fat, and waist-hip ratio were associated with deep pockets.
Nishida et al. (2005)	Japan	372	20-59	BMI > 26 was associated with periodontitis
Khader at al. (2009)	Jordan	340	18-70	-Obesity was significantly associated with increased prevalence, severity, and extent of periodontal disease.

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2.2.5.2.3 Obesity and traumatic dental injuries

Obesity among schoolchildren has been pointed out as another risk factor to TDIs. The relationship between obesity and TDIs has been investigated in few studies (Petti, et al., 1997, Soriano, et al, 2007), However, the possible relationship between obesity and TDIs is still unclear. This relationship was hypothesized by the physical inactivity of obese children (Trost, et al., 2001) which may increase their proneness to TDIs because of clumsiness (Petti, et al., 1997). However, other studies showed that the physical activity of obese children was not significantly less than that of non obese ones (Reilly, et al., 2006).

While it was assumed that the sedentary life style would make obese children less exposed to TDIs than lean children, Petti et al. (1997) found that obesity significantly increased the risk of TDIs, with one third of obese subjects affected. The results of the study were explained by the less active life style of obese children comparing to non obese ones, indicating that an active lifestyle was a protective factor for TDIs. This unexpected inverse relationship between TDIs and active lifestyle suggested that children frequently playing sports and lively games are not only less obese but also more skillful (Reilly, et al., 2006), making them less prone to trauma. Another more recent study corroborates that being overweight may be related to the presence of traumatic dental injury (Nicolau, et al., 2001). In this study conducted in Brazil, the authors focused on the importance of health promotion policies to reduce fat and sugar consumption as well as increase safe physical activities of children, since this would help overweight children not only to lose weight but also to make them more skillful, less likely to fall, and consequently less prone to TDIs.

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Another cross-sectional study in Brazil (Soriano, et al., 2009) has investigated the relationship between obesity and TDIs. However, different methodologies were used. Soriano et al. (2009) in a study investigating the prevalence and risk factors related to TDIs among 12-year-old school children in Brazil, evaluated obesity according to references from National Center for Health Statistics (NCHS) using frequency distribution of the sample studied instead of the international CDC growth charts specific for age and sex. TDIs were more prevalent among obese children, nevertheless; there was no statistically significant association between TDIs and obesity. These results were in disagreement with those obtained by Granville-Garcia et al. (2006) who found that overweight/obese children in Brazil had 2.5 times more trauma than non-overweight/obese ones. However, this study was carried out on younger age groups (1-5 years), suggesting that obesity might act as a risk factor for TDIs in younger children.

In Arab countries, only one study carried out on 13 to 14 years old school children in Kuwait to investigate the influence of obesity on TDIs. No significant association was reported. This was explained by the minimal impact of obesity on the communication skills of children in the society (Ărtun and Al-Azemi, 2009). One shortcoming of this study is that obesity was scored if BMI exceeded 30; a method used in the adult population rather than children and adolescents.

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Table 6. Studies on the relationship between obesity and traumatic dental injuries

Author	Country	N	Ages in years	Conclusions
Petti et al.(1997)	Italy	938	6-11	-Obesity significantly increased the risk of TDIs. One-third of obese children was affected vs. only one fifth of other subjects.
Nicolau et al. (2001)	Brazil	652	13	-Being from a non-nuclear family, overweight and a boy increased the risk of having a TDI. -Overweight children were 1.93 times more likely to have dental injuries than those who were not overweight.
Granville-Garcia et al. (2006)	Brazil	2651	1-5	-Overweight/obese children had 2.5 times more trauma than non-overweight/obese ones
Soriano et al. (2009)	Brazil	1046	12	-Obese subjects sustained more TDIs than non-obese subjects. However, it was concluded that the presence of obesity was not associated to TDIs in adolescents from Recife, Brazil.
Ărtun and Al-Azemi, (2009)	Kuwait	1583	13-14	-No difference was detected in TDIs rate among the subjects in the three BMI categories.

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2.2.6 Assessment of obesity in the dental office

Considering the alarming increase in overweight and obesity, treating overweight persons in the dental office will become more and more common (Pischon, et al., 2007). Until recently, anthropometric parameters were rarely measured in clinical practice, and a definite diagnosis of obesity was rarely made by physicians (Cleator, et al., 2002). If obesity is to be acknowledged as a multiple-risk-factor syndrome for overall and oral health, general and oral risk assessment in the dental office should include the evaluation of body mass index and waist circumference on a regular basis (Pischon, et al., 2007).

Oral health and obesity are closely associated with dietary intake, which makes dietary counseling for children and adolescents concerning oral health problems, including dental caries, periodontal disease, and obesity, mandatory to reduce the risk of periodontal disease (Saito and Shimazaki, 2007).

Due to increased distribution in body fat, drug pharmacokinetics is altered in obese children. In pediatric dentistry, this is of particular importance when using sedative agents (Baker and Yagiela, 2006). Obesity in children became a challenge pediatric dentistry should not ignore (Bimstein and Katz, 2010).

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Chapter Three: Methodology

3.1 Ethical approval

Before the commencement of the study, the research protocol was approved by the Institutional Review Board (IRB) at the University of Jordan (Appendix II). Permission from the Ministry of Education and the United Nations Relief and Works Agency (UNRWA) headquarter was also obtained for the examination of schoolchildren. The selected schools were invited to participate in the study through formal letters attached with the required authorities' permission. Prior to data collection, all parents or legal guardians were asked to sign a written informed consent form authorizing the enrollment of their children in the project. Through which, the study purposes, relevance, and possible benefits arising from its development, were explained (Appendix III). Negative consent was accepted without any prejudice attached to the children who had opted not to participate.

3.2 The study design and population

A cross-sectional survey was performed with the target population comprising children aged 12 years regularly attending private, public, UNRWA schools in Amman-the capital of Jordan, and neighboring regions of the middle Badia. A stratified, two-stage random cluster sample design was applied, using schools as the primary sampling unit. Data was collected over a two month period in the year 2010.

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3.2.1 Sample size

According to the formula:

$$n = \frac{Z^2 pq}{e^2}$$

n=sample size

Z= standard normal deviate corresponding to a 95% confidence interval (1.96)

p= the estimate of prevalence of TDI in the studied population

q=1-p

e=precision level (0.05)

It was estimated that a minimum sample size of 183 children was required to achieve a level of precision with a standard error of 5 percent. The 95% confidence interval level and a prevalence of 13.8 percent were used for calculation. The decision to use a prevalence of 13.8 percent was adopted from a previous study carried out in Amman-the capital of Jordan (Hamdan and Rajab, 2003). The required sample size was increased to avoid Type II sampling error and to decrease the effect of confounding variables.

3.2.2 Sampling procedure

The lists of schools, their address, phone numbers, number of classes and children in the 6th grade were obtained from the Department of Statistics/ Ministry of Education in Jordan. According to official figures, there were 48494 children attending the 6th grade in 960 schools in Amman , and neighboring regions of the middle Badia.

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Using a random sample generator on an electronic website (http://stattrek.com/), cluster random sample was selected from Amman five directorates and Al-Jeeza in the middle Badia, representing the urban, and rural areas of Amman, respectively.

The first stage comprised listing all schools having 6th grade classes in Amman. Then, dividing the schools into four different administrative categories; private, public, (UNRWA), and schools of the rural areas. Each category was sub-divided into three sub- categories according to gender; male, female, and mixed schools. A random selection of ten schools of each category was performed through the random sample generator. More than the required number of schools was picked, so that, if for any reason, a school refused to participate in the study, another one was replaced from the same category. Schools for children with special-needs were excluded.

The second stage of sampling comprised selection of children from the previously selected schools. A 6th grade class was randomly selected in each school. The sample selection process took into account proportional representation; since the number of students in each class was not constant and differs between school types, the number of children selected was proportional to the number of 6th grade students in each school type. The sampling procedure stopped when the required sample size was achieved.

The final sample size of this survey included 1025 children, 260 from private schools, 360 from public schools, 210 from UNRWA, and 195 in rural areas, taking proportionality into consideration (Appendix IV).

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3.3 The questionnaire

A previously tested short questionnaire was included in the consent form to obtain information about two socioeconomic indicators; education and income (Appendix III). It included questions about parent's educational level (less than high school, high school, diploma, bachelor, master and PhD) and family income (less than enough, enough, more than enough) to be answered by parents in case they approve on their children participation.

3.4 Diagnostic criteria of traumatic dental injuries

The study sample included 12-year-old schoolchildren, who returned positive consent forms approved by their parents/ legal guardian on the day of interview and examination. TDIs were diagnosed by clinical examination. Other diagnostic aids such as; radiographic examination and pulp vitality test, were not used for the diagnosis of TDIs in this survey. The study was limited to anterior permanent incisor teeth as other teeth are seldom traumatized.

The epidemiological classification of traumatic dental injuries including codes of the WHO International Classification of Diseases to Dentistry and Stomatology and modified by Andreasen et al. (2007) was adopted (Appendix V). According to this classification, children were categorized into six groups as shown in Table 7.

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Table 7. Epidemiological classification of traumatic dental injuries including codes of the WHO International Classification of Diseases to Dentistry and Stomatology (Andreasen, et al., 2007).

Code	Injury	Criteria
0	No injury	No evidence of treated or untreated dental injury.
1	Treated dental injury	Composite restoration, bonding of the tooth fragment, crown, and denture or bridge pontics replacing missing teeth due to TDI, restoration located in the palatal/lingual surface of the crown suggesting endodontic treatment and no evidence of decay, or any other treatment provided due to TDI.
2	Enamel fracture only	Loss of small portion of the crown, including only the enamel.
3	Enamel/Dentin fracture	Loss of a portion of the crown, including enamel and dentin without pulp exposure.
4	Pulp injury	Signs and symptoms of pulp involvement due to dental injury. It includes fractures with pulp exposure, dislocation of the tooth, presence of sinus tract and/or swelling in the labial or lingual vestibule without evidence of caries and dislocation of the crown.
5	Missing tooth due to trauma	Absence of the tooth due to a complete avulsion.
9	Excluded tooth	Signs of traumatic injury cannot be assessed, i.e. presence of appliances or all permanent incisors missing due to caries.

Types of treatment provided and needed criteria were also recorded according to previously adapted protocols (Cortes, et al., 2001, Livny, et al., 2010) (Appendix V).

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3.5 Exclusion criteria

Schoolchildren with negative consents were not interviewed or examined. The present survey excluded any child with a medical condition that would affect his/her growth, and consequently anthropometric parameters. Moreover; children undergoing fixed orthodontic treatment were excluded from the study.

3.6 Clinical examination

3.6.1 Examiner reliability

All clinical examinations were carried out by one examiner (T.B.) who was trained and calibrated by a University Professor of Pediatric Dentistry (L.R.), for anthropometric measurement, oral examination, and the criteria used to identify dental injuries before the commencement of the study. There was 98.3 percent agreement during calibration. During the examination process, intra-examiner reliability was checked through duplicate examination of every 10^{th} subject at the end of the day. Consequently, 50 children were examined twice and high intra-examiner kappa value of 92.3 was obtained indicating a very good agreement.

3.6.2 Interview

Before examination, a note about medical history was obtained from schoolchildren verified by the teacher of the class, in order to guarantee a valid BMI values. All subjects were interviewed for participation in sports, their favorite sport type, and

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whether or not they use a mouthguard. Only those who had clinical evidence of TDIs were interviewed regarding details of the injury event including when, where, how, season, and the nature of activity when the injury occurred. Answers and examination measurements were recorded on a prepared survey sheet formed by the researcher (Appendix V).

3.6.3 Oral examination

Lip coverage was observed when the child first entered the examination room and recorded later according to the criteria adopted by Burden (1995). If the lip covered the upper incisors during the rest position, lip coverage was rated as adequate. If lips were not touching each other during the rest position and the greater part of the crown height of the upper incisors was exposed and clearly visible, lip coverage was rated as inadequate (Burden, 1995). Incisal overjet was measured in millimeters using disposable rulers, from the labial surface of the mandibular incisors to the incisal edge of the most prominent maxillary incisor, with the ruler being held parallel to the occlusal plane and radial to the arch (Burden, 1995).

Dental examination was conducted using individually wrapped and sterilized dental mirrors. Probes were used to detect composite restorations. Children were seated and examined in a room with good natural lighting supplemented with a portable head light. The universal infection control precautions were followed during examination, and gauzes were used to dry teeth and remove any residual debris when necessary. Only anterior permanent incisor teeth (eight teeth) were examined.

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3.6.4 Anthropometric measurements

Weight and height were measured by the researcher (T.B.) for each subject according to standard methods (CDC, 2000, Ogden, et al., 2002).

3.5.4.1 Weight

Weight was measured in kilograms (Kg) using digital scaler which was checked for zero balance before each measurement. According to CDC recommendations (http//.cdc.gov/healthyweight), the scaler was placed on firm flooring rather than carpet. Children were asked to remove shoes and heavy clothing and stand with both feet on the center of the scale

3.5.4.2 Height

Height was measured in centimeters (cm) using a meter setup measure fixed to the wall. According to CDC recommendations (http//.cdc.gov/healthyweight), the subject stood erect without shoes; so that the line of sight was horizontal and the heels, the subscapale, shoulders, and the head were aligned with the wall. The distance from the sole of the feet to the top of the head was measured to the nearest 0.1 cm.

BMI was calculated during data analysis according to the formula: BMI=Weight (kg)/ Height (m^2) (CDC, 2000).

Overweight and obesity were assessed after referring to the CDC growth charts specific for age and sex (Appendix I). After referring to CDC-growth charts;

- Boys with BMI $\geq$ 24.2 were considered obese.
- Girls with BMI $\geq$ 25.2 were considered obese.

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3.7 Data analysis

Data were entered into statistical computer program, Statistical Package for Social Sciences, version 17 (SPSS Inc., Chicago, IL, USA). Data entry was rechecked by running frequencies for all variables included in the study. Strange readings were rechecked on the paper forms and corrected in the program.

Data analysis included descriptive statistics, comparisons and test of association. Descriptive statistics in this study included frequency distribution of schoolchildren in relation to other variables (demographic data, physical activity, anthropometric measurements, oral and dental measurements, and traumatic dental injuries occurrence with related details of the injury events). Means of anthropometric measurements (maximum, minimum, and standard deviation) with representative histograms were also demonstrated within the descriptive analysis. Kappa test was used to test intra-examiner reliability.

Statistical analysis of association of traumatic dental injuries with various variables was performed using Chi-square procedures. Probability values ≤ 0.05 were considered statistically significant. Stepwise Logistic regression procedures were carried out to identify factors collectively associated with traumatic dental injuries. Odds ratios were also calculated with 95% test-based confidence intervals for the associated variables.

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Chapter Four: Results

From the total of 1780 consent forms distributed, 1025 were returned by schoolchildren with a response rate of 57.6 %. Figure 1 illustrates the response rate in each school category and Figure 2 illustrates the response rate in each school category according to gender.

Clinical examinations were performed afterwards by a single examiner (T.B) during period from October to December in the year 2010.

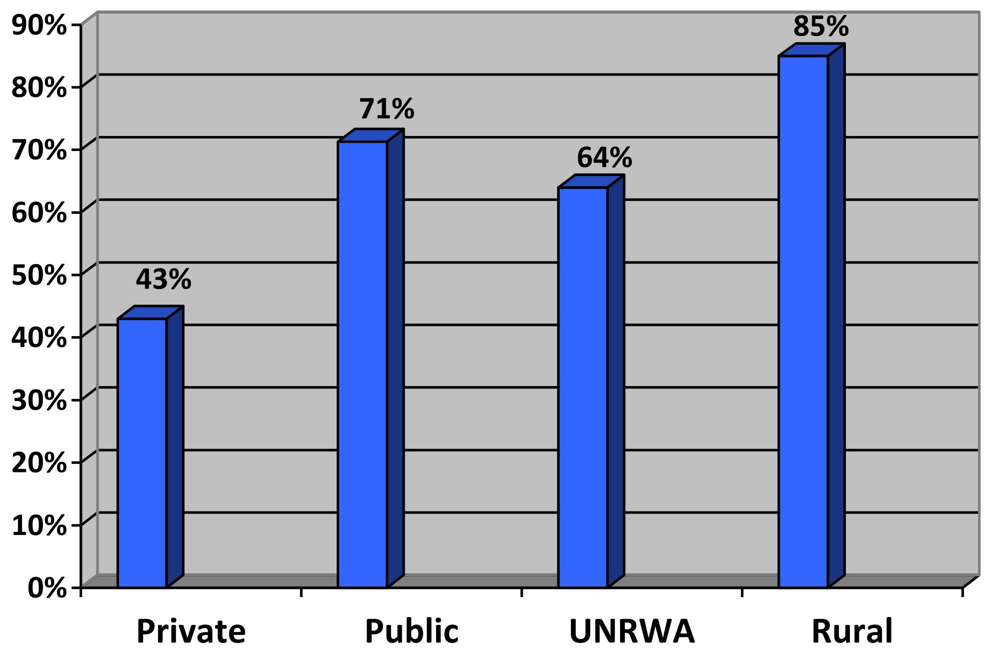


Figure 1. Response rate among subjects by school categories

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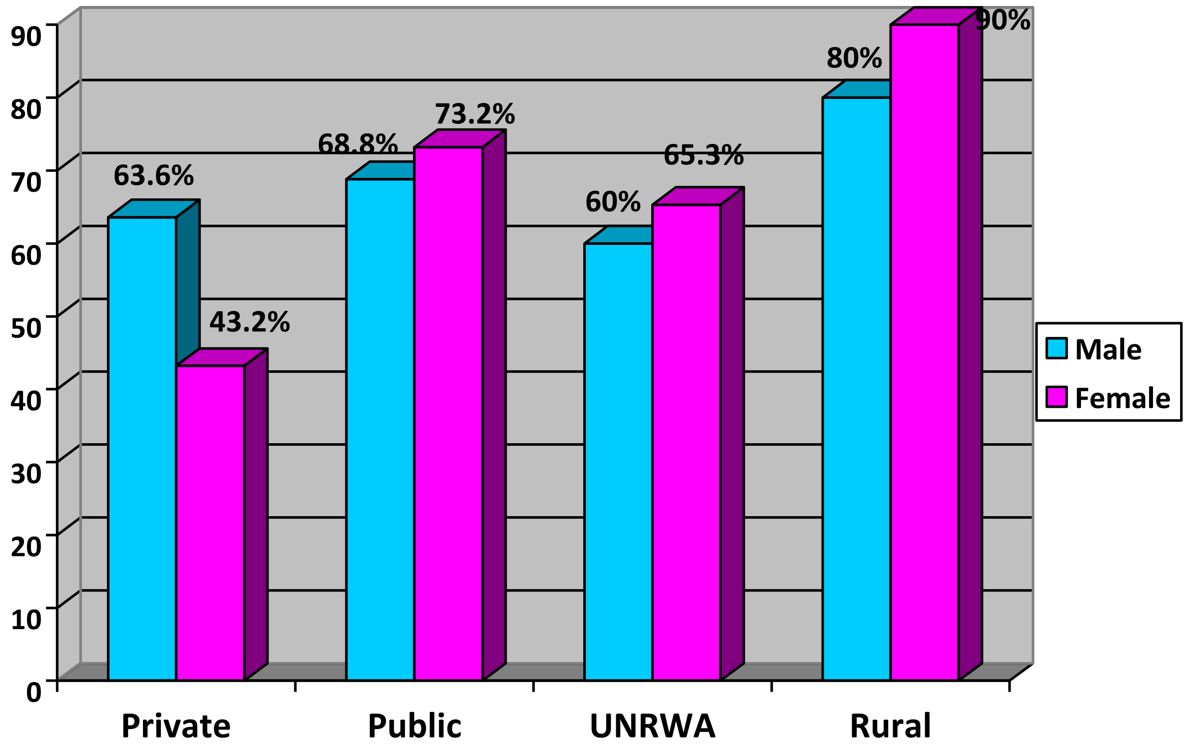


Figure 2. Response rate in each school category according to gender

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4.1 Demographic characteristics of the sample

Demographic characteristics of the sample are outlined in Table 8. Of the total 1025 schoolchildren who returned the consent forms, 10 were excluded (nine undergoing fixed orthodontic treatment and one with a medical condition that affects the bone). The final number of examined schoolchildren was 1015, with 53.7% males and 46.3% females. Approximately 81% of the schoolchildren were from urban areas and 19% from rural areas. The largest proportion of schoolchildren (36%) was from public schools, a quarter from private schools, and nearly equal proportions of children participated from UNRWA and rural areas.

Table 8. **Demographic characteristics of the sample (N=1015)**

Variable	Category	N (%)
Gender	Male	545 (53.7)
	Female	460 (46.3)
School area	Urban	821 (80.9)
	Rural	194 (19.1)
School type	Private	250 (24.6)
	Public	361 (35.6)
	UNRWA	210 (20.7)
	Rural	194 (19.1)
Father's education level	High school or less	562 (55.4)
	Diploma, Bachelor	384 (37.9)
	Post graduate degree	69 (6.8)
Mother's education level	High school or less	638 (62.9)
	Diploma, Bachelor	334 (32.9)
	Post graduate degree	43 (4.2)
Family income	Less than enough	322 (31.7)
	Enough	658 (64.8)
	More than enough	15 (1.5)
	No answer	20 (2.0)
	Total	1015 (100)

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Table 9 presents the distribution of the sample by gender according to school type, residence area, and socioeconomic indicators. There was similar distribution of schoolchildren according to gender in both urban and rural areas. While higher proportions of males were presented in private schools (64.4%), in UNRWA (59.5%) and in rural areas (53.1%), public schools had more participation of females (56.8% vs. 43.2%). Most schoolchildren from parents with middle and high education level were males. More proportions of males were from families with enough and less than enough income (53.2% and 54.7% respectively).

Table 9. Distribution of schoolchildren (N=1015) by gender according to demographic data

Variable	Category	Male N (%)	Female N (%)	Total N (%)
Residence	Urban	442 (53.8)	379 (46.2)	821 (100)
	Rural	103 (53.1)	91 (46.9)	194 (100)
School type	Private	161 (64.4)	89 (35.6)	250 (100)
	Public	156 (43.2)	205 (56.8)	361 (100)
	UNRWA	125 (59.5)	85 (50.5)	210 (100)
	Rural	103 (53.1)	91 (46.9)	194 (100)
Father's education level	High school or less	286 (50.9)	276 (49.1)	562 (100)
	Diploma, Bachelor	219 (57)	165 (43)	384 (100)
	Post graduate degree	40 (58)	29 (42)	69(100)
Mother's education level	high school or less	332 (52)	306 (48)	638 (100)
	Diploma, Bachelor	187 (56)	147 (44)	334 (100)
	Post graduate degree	26 (60.5)	17 (39.5)	43 (100)
Family income	Less than enough	176(54.7)	146 (45.3)	322 (100)
	Enough	350(53.2)	308 (46.8)	658 (100)
	More than enough	6 (40)	9 (60)	15 (100)
	No answer	13 (65)	7 (35)	20 (100)
	Total	545 (53.7)	470 (46.3)	1015 (100)

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4.2 Physical activities

Almost two thirds of the sample were practicing sports regularly (Table 10). Among those, football was the favorite sport type reported by 66.2% of schoolchildren. Running was practiced by 13.4%, basketball by 6.4%, and swimming by 5.7%. Kickboxing got the lowest score result (0.3%). Only six schoolchildren reported using a mouthguard during contact sports, of those four were practicing taekwondo regularly.

Table 10. Distribution of schoolchildren (N=1015) according to physical activities and use of protective device

Variable		**N (%)**
Practicing sport regularly	Yes	627 (61.8)
	No	388 (38.2)
	Total	1015 (100)
Favorite sport	Football	415 (66.2)
	Basketball	40 (6.4)
	Handball	5 (0.8)
	Swimming	36 (5.7)
	Kickboxing	2 (0.3)
	Taekwondo	15 (2.4)
	Tennis	19 (3.0)
	Running	84 (13.4)
	Others	11 (1.8)
Use of protective device during sports	Yes	9 (1.5)
	No	618 (98.5)
	Total	627 (100)

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Table 11 shows the distribution of physical activities practiced by schoolchildren by gender. Males were almost as twice as females in practicing sports (67.9% and 32.1%, respectively). Only one girl opposite to four boys wears a ready-made mouthguard during practicing taekwondo. One boy reported using a custom mouthguard, made by his pediatric dentist, while playing American football. Three children (one girl, two boys) reported using a facemask rather than a mouthguard. The boys used it during taekwondo, and the girl while joining a football club.

Table 11. Distribution of schoolchildren (N=1015) by gender according to physical activities and use of protective device during sports

Variable	Category	Male N (%)	Female N (%)	Total N (%)
Practicing sport regularly	Yes	426(67.9)	201(32.1)	627 (100)
	No	119(30.8)	269(69.2)	388 (100)
				1015(100)
Favorite sport	Football	361(87.0)	54 (13.0)	415 (100)
	Basketball	25(65.5)	15 (35.5)	40 (100)
	Handball	3(60.0)	2 (40.0)	5 (100)
	Swimming	17(47.2)	19 (52.8)	36 (100)
	Kickboxing	1(50.0)	1 (50.0)	2 (100)
	Taekwondo	7(46.7)	8 (53.3)	15 (100)
	Tennis	2(10.5)	17 (89.5)	19 (100)
	Running	6 (7.1)	78 (92.9)	84 (100)
	Others	3(27.3)	8 (72.7)	11 (100)
Use of protective device during sports	Yes	7(77.8)	2(22.2)	9 (100)
	No	418(67.6)	200(32.4)	618 (100)
				627 (100)

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The distribution of schoolchildren by physical activities according to school type and residence area is presented in Table 12. The majority of schoolchildren practicing sports were from urban areas (83%), and 31% attending public schools. Those who used a protective device were all from urban areas; four from private schools, three from public schools, and two from UNRWA.

Table 12. Distribution of schoolchildren (N=1015) by physical activities and use of protective device during sports, according to school type and residence area

Variable	Practicing sports		Protective device	
	Yes N (%)	**No N (%)**	**Yes N (%)**	**No N (%)**
Urban	519 (63.2)	302 (36.8)	9 (1.7)	510 (98.3)
Rural	108 (55.2)	86 (44.8)	0 (0)	108 (100)
Private	179 (71.6)	71 (28.4)	4 (2.2)	175 (97.8)
Public	192 (53.3)	168 (46.7)	3 (1.6)	189 (98.4)
UNRWA	149 (72.6)	56 (27.4)	2 (1.3)	147 (98.7)
Rural	107 (55.2)	87 (44.8)	0 (0)	107 (100)
Total	627 (61.8)	388 (38.2)	9 (1.5)	618 (98.5)

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4.3 Anthropometric measurements

4.3.1 Weight

The distribution of weight (Kg) among schoolchildren followed a normal distribution curve as shown in Figure 3.

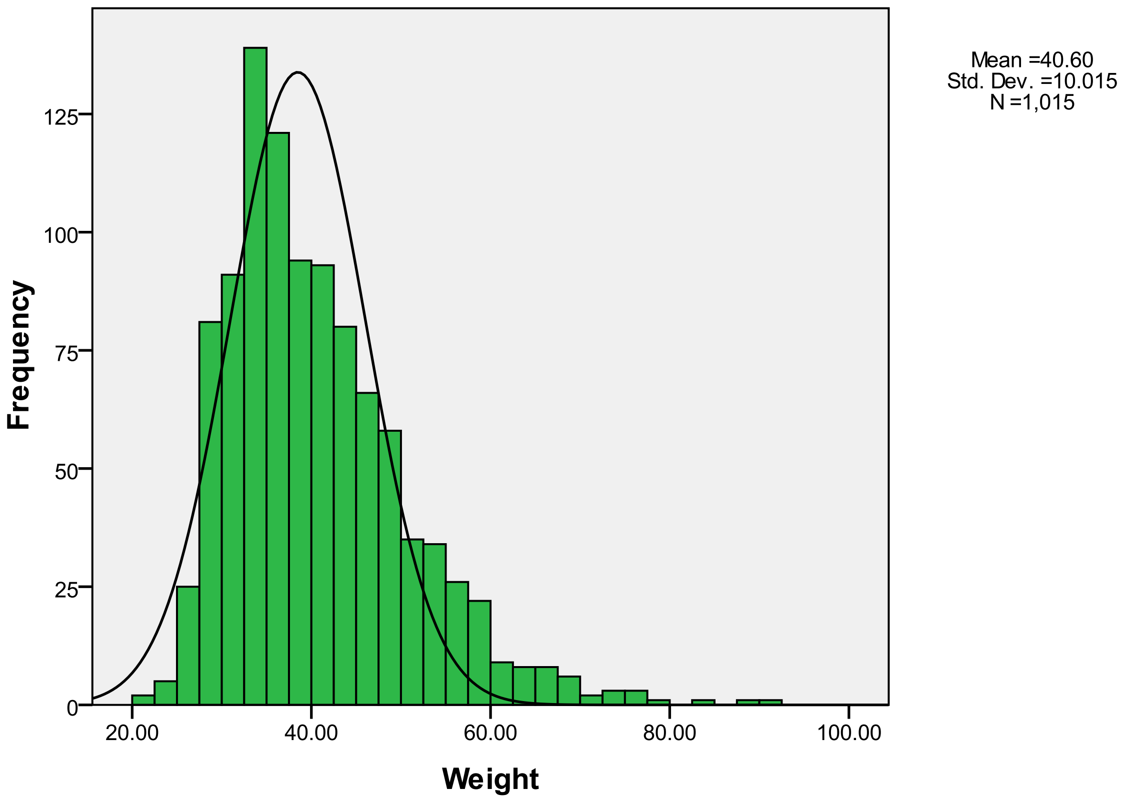


Figure 3. Normal distribution of weight measurements (Kg) in the study sample (N=1015)

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Table 13 presents the statistics of weight (Kg) in the sample and in both genders. The average of schoolchildren's weight was 40.6 Kg with 10 standard deviations. Maximum value reached 92.3 Kg while minimum was 22.2 Kg, and the median was 38.6.

Table 13. Statistics of weight (Kg)

	Study Sample	Male	Female
N	1015	545	470
Mean	40.60	39.81	41.52
Median	38.60	37.20	39.90
Std. Deviation	10.01	10.26	9.65
Skewness	1.13	1.29	0.98
Std. Error of skewness	0.08	0.11	0.11
Minimum	22.20	23.00	22.2
Maximum	92.30	87.50	92.3

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4.3.2 Height

The distribution of height (m) among schoolchildren followed a normal distribution curve as shown in Figure 4.

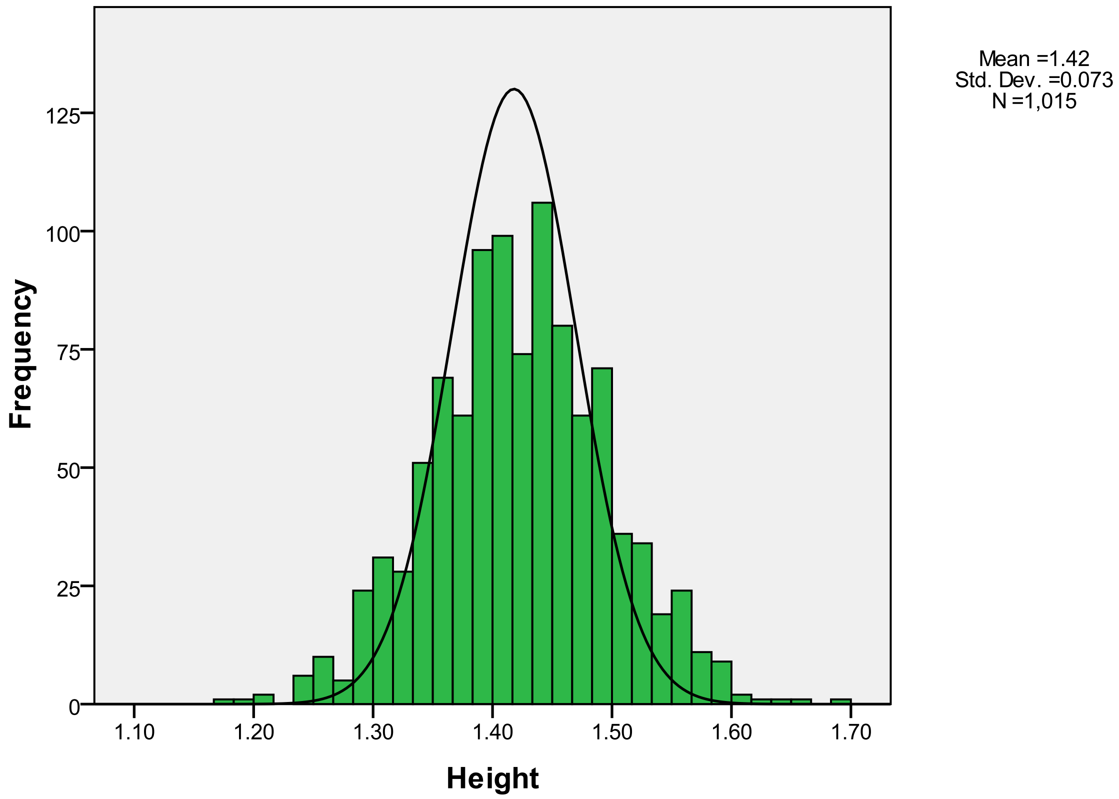


Figure 4. Normal distribution of height measurements (m) in the study sample (N=1015)

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Table 14 presents the statistics of height (m) in the sample and in both genders. The average of schoolchildren's height was 1.42 m with 0.07 standard deviations. Maximum value reached 1.69 m while minimum was 1.18 m, and the median was 1.43.

Table 14. Statistics of height (m)

	Study Sample	Male	Female
N	1015	545	470
Mean	1.42	1.41	1.44
Median	1.43	1.42	1.44
Std. Deviation	0.07	0.07	0.07
Skewness	0.02	0.11	0.11
Std. Error of skewness	0.08	0.11	0.11
Minimum	1.18	1.18	1.20
Maximum	1.69	1.64	1.70

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4.3.3 Body Mass Index (BMI)

Table 15 presents the statistics of BMI in the sample and in both genders. The average of schoolchildren's BMI was 19.87 with 3.69 standard deviations. Maximum value reached 38.99 m while minimum was 13.7, and the median was 18.89.

Table 15. Statistics of body mass index

	Study Sample	Male	Female
N	1015	545	470
Mean	19.87	19.69	20.07
Median	18.89	18.85	19.22
Std. Deviation	3.69	3.78	3.57
Skewness	1.27	1.36	1.18
Std. Error of skewness	0.78	0.10	0.11
Minimum	13.70	13.70	13.72
Maximum	38.99	38.99	35.77

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4.3.4 Obesity

112 children were found to be obese according to the CDC growth charts, representing 11% prevalence of obesity among the studied population (Table 16). About 70% of children fell under healthy weight category specific to age and sex. Only 1.5% was underweight and around 16% were overweight (Figure 5).

Table 16. Obese versus non- obese children

	Male N (%)	Female N (%)	Total N (%)
non obese	476 (87.3)	427 (90.9)	903 (89)
obese	69 (12.7)	43 (9.1)	112 (11)
Total	545 (100)	470 (100)	1015 (100)

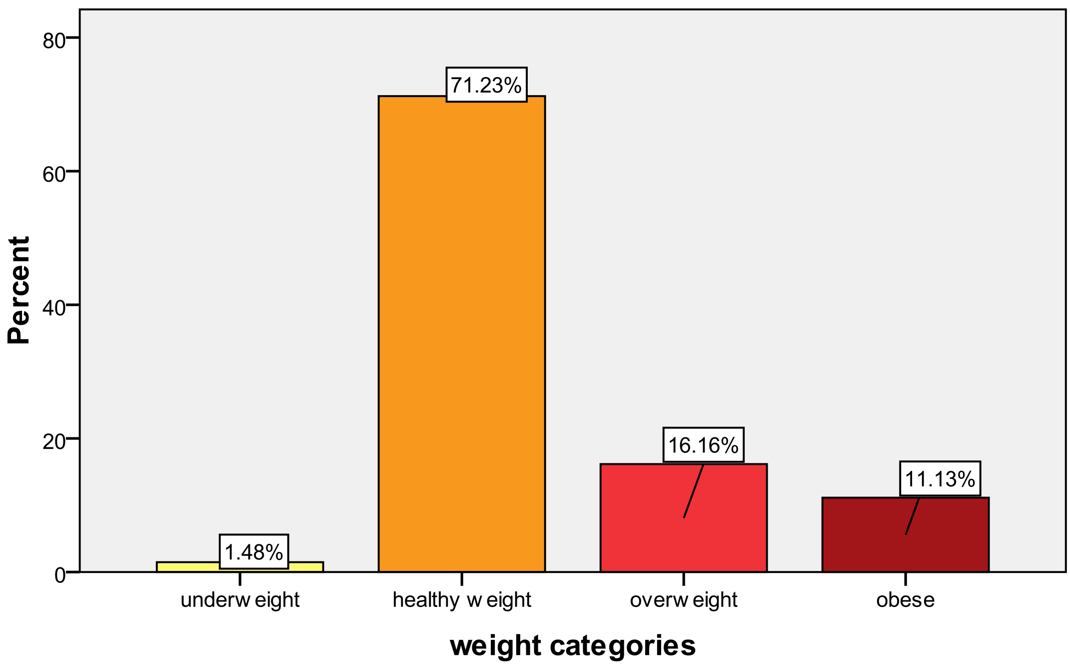


Figure 5.Weight categories among the study sample (N=1015) according to Center for Disease Control and Prevention growth charts.

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As shown in Table 17, more males (12.7%) were obese than females (9.1%). However, 17.9% of females participated in the study were overweight comparing to 14.7% of males. Nearly equal proportions of both genders fell under healthy weight category. The difference in weight category between males and females was statistically significant (P<0.05).

Table 17. Distribution of study sample (N=1015) according to weight categories

Weight Category	Male N (%)	Female N (%)	Total N (%)
underweight	12 (2.2)	3 (0.6)	15 (1.5)
healthy weight	384 (70.5)	339 (72.1)	723 (71.2)
overweight	80 (14.7)	85 (17.9)	165 (16.3)
obese	69 (12.7)	43 (9.1)	112 (12.7)
Total	545 (100)	470 (100)	1015 (100)

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4.4 Dental and oral measurements

Fourty one percent of schoolchildren had increased overjet above 3 mm (Table 18), and 54.3% had inadequate lip coverage (Table 19). In most children (80%) upper lip covered only two thirds of the labial surfaces of maxillary incisors. Lower lip covered only one third of the labial surface of maxillary incisors in more than half of the schoolchildren.

Table 18. Distribution of study sample (N=1015) according to overjet size

Overjet Size	N (%)
Overjet up to 3mm	598 (58.9)
Overjet above 3 mm	417 (41.1)
Total	1015 (100.0)

Table 19. Distribution of study sample (N=1015) according to lip coverage

Lip Coverage	N (%)
Adequate	464 (45.7)
Inadequate	551 (54.3)
Total	1015 (100.0)

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4.5 Traumatic dental injuries

4.5.1 Prevalence

Of all schoolchildren examined, 165 had traumatic dental injuries (TDIs), indicating an overall prevalence of 16.3% in 12-year-old Jordanian schoolchildren living in Amman. The distribution of TDIs according to demographic characteristics is outlined in Table 19. Males had significantly higher prevalence of TDIs than females (18.9% vs. 13.5%; P<0.05). Schoolchildren from rural areas had higher prevalence of TDIs compared to those from urban areas (19.1% compared to 15.6%). However, the difference was not statistically significant (P>0.05). Children in private schools had the highest prevalence of TDIs (16.4%). UNRWA and public schools had similar distribution of TDIs (15.2%). The difference in TDI occurrence between school types was not statistically significant (P>0.05).

Table 20. Prevalence of traumatic dental injuries to the permanent incisors in a sample of 1015 schoolchildren aged 12-year-old by gender according to demographic characteristics

Variable	Category	Diagnosis		Total	P-Value
		TDI N (%)	No TDI N (%)	N (%)	
Gender	Male	103 (18.9)	442 (81.1)	545 (100)	P= 0.014
	Female	62 (13.5)	408 (86.8)	470 (100)	
Residence	Urban	128 (15.6)	693 (84.4)	821 (100)	P= 0.237
	Rural	37 (19.1)	157 (80.9)	194 (100)	
School type	Private	41 (16.4)	209 (83.6)	250 (100)	P= 0.666
	Public	55 (15.2)	306 (84.8)	361 (100)	
	UNRWA	32 (15.2)	178 (84.8)	210 (100)	
	Rural	37 (19.1)	157 (80.9)	194 (100)	
Total		165 (100)	850 (100)	1015 (100)	

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Table 21 presents the distribution of schoolchildren by TDIs according to parents' education level and family income. It is clear that none of the socioeconomic indicators had a significant effect on TDI occurrence (P>0.05).

Table 21. Distribution of schoolchildren (N=1015) by traumatic dental injuries according to socioeconomic indicators

Variable	Category	Diagnosis		Total	P-Value
		TDI N (%)	No TDI N (%)	N (%)	
Father's Education Level	high school or less	90 (16.3)	472(83.7)	562(100)	P=0.915
	Diploma, Bachelor	63 (16.4)	321(83.6)	384(100)	
	Post graduate degree	12 (17.4)	57(82.6)	69(100)	
Mother's Education Level	high school or less	103(16.1)	535(83.9)	548(100)	P=0.369
	Diploma, Bachelor	54(16.2)	280(83.9)	334(100)	
	Post graduate degree	8(18.6)	35(81.4)	43(100)	
Family Income	Less than enough	52(16.1)	270(83.9)	322(100)	P=0.638
	Enough	110(16.7)	548(83.3)	658(100)	
	More than enough	1 (6.7)	14(93.3)	15(100)	
	No answer	2(10.0)	18(90.0)	20(100)	
Total		165 (100)	850 (100)	1015(100)	

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Table 22 shows the distribution of schoolchildren by TDIs according to physical activities. Children practicing sports regularly had more TDIs (17.6%) than less active children (14.6%). However, the relationship was not statistically significant (P>0.05).

Table 22. Distribution of schoolchildren (N=1015) by traumatic dental injuries according to physical activities

Variable	Category	Diagnosis		Total	P-Value
		TDI N (%)	No TDI N (%)	N (%)	
Practicing Sports Regularly	Yes	110(17.6)	516(82.4)	627(100)	P= 0.15
	No	55 (14.1)	334 (85.9)	489 (100)	
		165 (100)	850 (100)	1015 (100)	
Favorite Sport Type	Football	84 (20.2)	331 (79.8)	415 (100)	P= 0.307
	Basketball	4 (10.0)	36 (90.0)	40 (100)	
	Handball	1 (20.0)	4 (80.0)	5 (100)	
	Swimming	5 (13.9)	31 (86.1)	36 (100)	
	Kickboxing	1 (50.0)	1 (50.0)	2 (100)	
	Taekwondo	3 (20.0)	12 (80.0)	15 (100)	
	Tennis	2 (10.5)	17 (89.5)	19 (100)	
	Running	9 (10.7)	75 (89.3)	84 (100)	
	Others	1 (9.1)	10 (90.9)	11 (100)	
Protective device	Yes	0 (.0)	9 (100)	9 (100)	P=0.256
	No	110 (17.8)	508 (82.2)	618 (100)	
Total		110 (100)	517 (100)	627 (100)	

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4.5.2 Teeth involved

A prevalence of 16.3% TDIs was found among the study sample with 220 teeth traumatized. Upper central incisors were the most common teeth exposed to trauma (92.7%) (Table 23).

Table 23. Distribution of injured teeth (N=220) according to tooth type.

Tooth Code	Trauma N (%)
12	4 (1.8)
11	99 (45)
21	105 (47.7)
22	1 (0.45)
32	1 (0.45)
31	2 (0.9)
41	7 (3.2)
42	1 (0.45)
Total	220 (100)

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As shown in Table 24, 66.1% of schoolchildren exposed to TDI had only one tooth involved, 32.1% had two teeth with dental injuries. Only one student had four teeth injured in a traffic accident.

Table 24. Distribution of schoolchildren (N=165) by number of injured teeth

Number of teeth	N (%)
1.00	114 (66.1)
2.00	48 (32.1)
3.00	2 (1.2)
4.00	1 (0.6)
Total	165 (100)

4.5.3 Type of traumatic dental injuries, treatment provided and treatment needed

As shown in Table 25, enamel fracture was the most common type of TDIs (65%), followed by enamel-dentin fracture (20%). Pulp involvement was observed in 17 traumatized teeth as pulp exposure, sinus tract, or discoloration. Two teeth were missing due to dental trauma. Only 14 TDIs were treated.

Table 25. Distribution of injured teeth according to the epidemiological classification adopted by WHO and modified by Andreasen et al. (2007)

WHO codes	Type of injury	N	%
0	**No sign of injury**	1100	83.3
1	**Treated injury**	14	1.0
2	**Enamel fracture only**	143	10.8
3	**Enamel/Dentin fracture**	44	3.4
4	**Pulp involvement**	17	1.3
5	**Missing teeth due to trauma**	2	0.2
Total		1320	100.0

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Treatment provided for those teeth ranged from simple composite resin restorations to replantation of one avulsed tooth (Table 26). The majority of injured teeth were untreated (93.6%).

Table 26. Distribution of treated injured teeth (N=14) according to treatment provided

Treatment provided	N	%
Acid etch restoration only	6	42.9
Restoration in the lingual surface only	0	0
Restoration in the lingual surface and other surfaces due to trauma	7	50.0
Bridge to replace missing Tooth due to trauma	0	0
Denture to replace missing tooth due to trauma	0	0
Replanted tooth	1	7.1
Total	14	100.0

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Among the 206 untreated injured teeth, 49% did not need treatment. Treatment needs included simple composite resin restoration (41.7%), root canal treatment (5.3%), and bleaching due to discoloration (3%) as outlined in Table 27. Only two cases needed fixed or removable prosthetic replacement for missing teeth.

Table 27. Distribution of untreated injured teeth (N=206) according to treatment needed

Treatment needed	N	%
No treatment needed	101	49.0
Acid etch restoration only	86	41.7
Acid etch restoration and root canal treatment	11	5.3
Acid etch restoration and root canal treatment and bleaching	6	3.0
Denture	2	0.5
Total	206	100

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4.5.4 Details of injury

Seventy nine schoolchildren exposed to TDIs (48%) did not recall details about the injury. As shown in Table 28, for those who remembered, most injuries occurred at least one year before the examination (32.6%).

Table 28. Distribution of schoolchildren with injured teeth (N=86) by time elapsed since the injury event

Time elapsed since injury (in months)	Total N (%)
.25	1 (1.2)
.30	1 (1.2)
1.00	1 (1.2)
2.00	2 (2.3)
3.00	2 (2.3)
4.00	2 (2.3)
12.00	28 (32.6)
24.00	24 (27.9)
36.00	19 (22.1)
48.00	5 (5.8)
60.00	1 (1.2)
Total	86 (100)

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About half of the children with injured teeth did not recall the time of injury. As shown in Table 29, the most common season in which the injury occurred was summer (34.5%).

Table 29. Distribution of schoolchildren with injured teeth (N=165) by gender and season in which TDI occurred

Season	Male N (%)	Female N (%)	Total N (%)
Spring	4 (3.9)	0 (0)	4 (2.4)
Summer	34 (33.0)	23 (37.1)	57 (34.5)
Winter	9 (8.7)	3 (4.8)	12 (7.3)
Autumn	6 (5.8)	4 (6.5)	10 (6.1)
don't know	50 (48.5)	32 (51.6)	82 (49.7)
Total	103 (100)	62 (100)	165 (100)

As presented in Table 30, most injuries occurred at home (30.9%), followed by street (13.3%).

Table 30. Distribution of schoolchildren with injured teeth (N=165) by gender and place of injury

Place of injury	Male N (%)	Female N (%)	Total N (%)
Home	25 (24.3)	26 (41.9)	51 (30.9)
School	15 (14.6)	2 (3.2)	17 (10.3)
Street	17 (16.5)	5 (8.1)	22 (13.3)
Playground	3 (2.9)	1 (1.6)	4 (2.4)
don't know	43 (41.7)	27 (43.5)	71 (43.0)
Total	103 (100)	62 (100)	165 (100)

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The leading cause of injury was fall (30.9%), followed by collision (17.1%) as outlined in Table 31. The same results were found in both genders. However, 43% did not recall the cause of injury.

Table 31. Distribution of schoolchildren with injured teeth (N=165) by gender and cause of injury

Cause of injury	Male N (%)	Female N (%)	Total N (%)
Fall	32 (31.1)	19 (30.6)	51 (30.9)
Collision	17 (16.5)	11 (17.7)	28 (17.0)
Sports	8 (7.8)	1 (1.6)	9 (5.5)
Traffic accidents	1 (1.0)	1 (1.6)	2 (1.2)
Inappropriate use of teeth	1 (1.0)	1 (1.6)	2 (1.2)
Biting hard items	1 (1.0)	1 (1.6)	2 (1.2)
don't know	43 (41.7)	28 (45.2)	71 (43.0)
Total	103 (100)	62 (100)	165 (100)

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4.5.5 Distribution of the sample by possible risk markers with TDIs

4.5.5.1 Oral and dental measurements

As shown in Table 32, having an increased overjet greater than 3 mm was significantly associated with TDIs (P<0.05). Of the 589 children with an overjet greater than 3 mm, 80 (19.2%) presented with TDI. By contrast, 14.2% of children with normal overjet had signs of dental trauma. Children with inadequate lip coverage had significantly higher prevalence of TDIs (20.7%) comparing to those with competent lips (11.0%). Both overjet and lip competence were significantly related to the occurrence of TDIs (P<0.05).

4.5.5.2 Obesity

As presented in Table 32, TDIs occurred more frequently in non obese children comparing to obese ones (16.9% vs.10.7%). Moreover, underweight children had the highest prevalence (20.0%) of TDIs followed by healthy weight and overweight children; 17.2% and 15.9%, respectively. However, the association was not statistically significant (P>0.05).

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Table 32. Distribution of the sample (N=1015) by possible risk markers with traumatic dental injuries

Variable	Category	Diagnosis		Total	P-Value
		TDI N (%)	No TDI N (%)	N (%)	
Overjet	Adequate	85(14.2)	513(85.8)	589(100)	P= 0.035
	Inadequate	80 (19.2)	337 (83.8)	417 (100)	
Lip Competence	Yes	51 (11.0)	413 (89.0)	464 (100)	P=0.000
	No	114 (20.7)	437 (79.3)	551 (100)	
Weight Categories	Underweight	3 (20.0)	12 (80.0)	15 (100)	P= 0.357
	Healthy weight	124 (17.2)	599 (82.8)	723 (100)	
	Overweight	26 (15.9)	138 (84.1)	164 (100)	
	Obese	12 (10.6)	101 (89.4)	113 (100)	
Obesity	Obese	12 (10.7)	100 (89.3)	112 (100)	P= 0.092
	Non obese	153 (16.9)	750 (83.1)	903 (100)	
Total		165 (100)	850 (100)	1015 (100)	

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4.5.6 Logistic regression analysis

Logistic regression analysis with a stepwise selection procedure was used to investigate the simultaneous influence of different independent variables that were significantly associated to TDI, the dependent variable. Whereby, the inclusion criterion for the independent variables to enter the model was set at 0.05 and the exclusion criterion to remove was set at 0.10. The level of significance was set at ≤ 0.05. All variables were included at the start and those failing to show a significant relationship were subsequently removed in a stepwise fashion. The best fit logistic regression model for the statistically significant variables is presented in Table 33.

Lip competence was significantly associated with TDI (P<0.05); children with inadequate lip coverage were about two times more likely to be exposed to dental trauma than those with competent lips (OR=1.947, 95% CI: 1.348-2.812). The odds of having TDI in males were about 1.4 times more compared to females (OR=1.424, 95% CI:1.007-2.014).

After entering the logistic regression model together with other significantly associated variables (Lip competence and gender), overjet did not show any significant association with TDI in the stepwise forward regression model as well as the backward model.

Table 33. Logistic regression analysis of variables related to traumatic dental injuries

Variable	Regression Coefficient	Standard Error	Wald	P-value	Exp(B)	95% C.I.for EXP(B)	
						Lower	Upper
Lip competence (*Inadequate)*	0.666	0.188	12.617	0.000	1.947	1.348	2.812
Gender *(Male)*	0.354	0.177	3.992	0.047*	1.424	1.007	2.014
Overjet (*Increased)*	0.195	0.177	1.212	0.271	1.215	0.859	1.718

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Chapter Five: Discussion

5.1 Study sample

The present study is the first population-based epidemiological survey on traumatic dental injuries and obesity carried out among 12-year-old schoolchildren living in Amman-the capital of Jordan. The culture within the Jordanian community might influence the prevalence of TDIs and the lifestyle of Jordanian children might influence their BMI values.

The study design was a cross-sectional one. The sample selection method was random to ensure representation of urban and rural areas, and the main types of schools in Amman-the capital of Jordan. The final sample size was almost equally distributed between males and females, and the distribution in the two areas (urban, rural) and the school type reflected the size of the population. The value of this population-based survey was in investigating two major common public health problems found in children. Exploring the association of obesity, together with other possible risk factors, and TDIs was important to avoid bias arising from other confounding variables. Assessing treated and untreated TDIs added an advantage to this survey that is not found in hospital-based and clinical-based studies resulting in a more accurate presentation of TDIs' prevalence in the population studied. The design of the study provides a valid estimation of the prevalence of TDIs and their association with possible risk factors; therefore, generalization of the results could be done easily to the population under investigation.

Out of the 1780 schoolchildren asked to participate in the study, only 1025 were examined yielding in a response rate of 57.6 percent. This relatively low response rate

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was mainly attributed to poor compliance of children in private schools. Parents claimed that the examination time would be on the expense of important school classes.

5.2 Diagnostic criteria

To define the "true" prevalence of TDIs in the studied population, the epidemiological classification adopted by the WHO and modified by Andreasen et al. (2007) was used. The prevalence of TDIs obtained using this classification can be directly compared to those recorded in other epidemiological surveys carried out in different countries (Glendor et al., 2007). The actual prevalence of TDIs is likely to be higher than the figure reported in this survey since the diagnostic criteria were limited to fractures of teeth and excluded luxation injuries. However, tooth discoloration was included in the 'pulp involvement' category of TDIs. Recording the presence of treated and untreated TDIs, and the types of treatment provided and treatment needed, was of great significance to address the urgent need for a public program to increase the awareness of parents and school teachers on the importance of TDIs management.

In order to ensure consistency in sample examination, examinations were performed by single researcher who underwent precise calibration before commencement of the study and whose reliability was tested during the examinations. The high intra-examiner agreement observed supports the validity of the methods used in the study.

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5.3 Traumatic Dental Injuries

5.3.1 Prevalence

The present study identified a prevalence of 16.3 percent of TDIs to the permanent anterior incisors among 12-year-old schoolchildren living in Amman- the capital of Jordan. This prevalence is lower than that found in a previous survey conducted in Jordan (19.2%) (Hamdan and Rock, 1995). However, it is higher when compared to 13.8 percent reported in a population-based study among similar age group in Amman (Hamdan and Rajab, 2003). This is explained by the different classification systems used.

The prevalence of TDIs in the present study was similar to that found among six grade schoolchildren in a recent study in four Palestinian towns (17.7%) (Livny et al., 2010), as well as in other epidemiological studies conducted previously in Brazil (Nicolau et al., 2001, Traebert et al., 2003, Traebert et al., 2006). However, lower prevalence was reported in other Middle Eastern countries: 11.5 percent in Iraq (Noori and Al-Obaidi, 2009), 11.7 percent in Syria (Marecenes et al., 1999), and 14.5 percent in Kuwait (Artun and Al-Azemi, 2009).

The differences in the prevalence of TDIs reported by various studies can be explained by the different methodology, diagnostic criteria, populations, and geographic and cultural variations in the studied populations.

In disagreement with previous studies (David, et al., 2009, Hamdan and Rock, 1995, Hamdan and Rajab, 2003), more prevalence of TDIs in the present study were found for children from rural areas (19.1%) comparing to urban areas (15.6%). However, the difference was not statistically significant. This finding might be attributed to the design

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of most houses in rural areas with playgrounds that allow outdoor activities for children all the time by contrast to departments' design in cities. This emphasizes on the need for safe playgrounds that could protect children from the traumatic consequences of falls and collisions especially in rural areas.

Children attending private schools experienced almost similar TDIs (16.4%) as others in UNRWA and public schools (15.2%). Nevertheless; there were no statistically significant differences in the experience of TDIs between children according to the types of schools. This showed that children from different social classes were distributed among different school types. The school type did not influence the prevalence of TDIs. This finding was in disagreement with Hamdan and Rajab (2003) who found higher prevalence of TDIs in children attending schools in unprivileged areas than children from private schools.

5.3.2 Type of traumatic dental injuries and teeth involved

In the present study, the most prevalent injury was fractures involving only enamel (65%) followed by fractures involving enamel and dentine (20%), this corroborate the findings of previous studies in several countries (Al-Majid et al., 2001, Hamdan and Rock, 1995, Marcenes et al., 1999, Naidoo, et al., 2009, Traebert et al., 2006, Soriano et al., 2007, Glendor, 2008,). Other authors reported enamel-dentin fracture as the most frequent injury to permanent incisors (Hamdan and Rajab, 2003, Livny, et al., 2010).

The diagnostic criteria used in the present study excluded root fractures, concussions, subluxations, and lateral luxations which are common in the permanent dentition but

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may not be visible by direct vision. This has made the cross-sectional study design of the present survey a contributory factor to the underestimated nature of the actual prevalence of TDIs usually noticed in epidemiological studies.

The upper central incisors were the most injured teeth (92.7%), which is similar to the findings of previous studies in Jordan and other countries (Al-Jundi, 2002, livny, et al., 2010, Rajab, 2003, Hamdan and Rajab, 2003). This is because the morphology and location of incisors make them more susceptible to TDIs (Soriano et al., 2007).

The majority of the affected children had only one traumatized anterior tooth (66.1%), while two teeth were traumatized in 53 (32.1%) children. This distribution is similar to that reported previously in the literature (Altun et al., 2009, Livny, et al., 2010).

5.3.3 Treatment provided and treatment needed

The prevalence of untreated trauma to the teeth for both genders was 93.6 percent in the present study, which is alarming. This shows that treatment of TDIs among schoolchildren is extremely neglected. However, because most injuries were enamel fractures, no treatment was needed for approximately half of TDIs in this survey. The same result was reported by Hamdan and Rajab (2003) who revealed that only 3.1 percent of traumatized teeth were treated, and in agreement with this survey; the proportion of teeth needing treatment was smaller than those untreated. Al Majid et al. reported that only 2.3 permanent maxillary incisors per thousand received treatment with composite in 12-14 year old boys in Saudi Arabia (Al-Majid et al., 2001). In a more recent study in Iraq, only 7 percent of traumatized anterior teeth received

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treatment and about half of the remaining did not need dental treatments (Noori and Al-Obaidi, 2009). In a study in South Africa, 85 percent of TDIs were untreated (Naidoo, et al., 2009). Similar results of untreated dental injuries were reported in Palestine (Livny, et al., 2010). This reflected a low priority of dental health relative to other health problems, and a poor access to dental services. Moreover; the cost of dental treatment may act as a barrier.

The main type of treatment provided was restoration in the lingual surface and other surfaces due to trauma (50%). This indicates possible root canal treatment due to improper evaluation of pulp status in TDIs by most dentists. The same finding was reported by (Al-Jundi, 2002), with 41.3 percent of children presenting with dental emergency due to trauma received elaborate dental procedures such as pulp therapy. In the present survey, only one avulsed tooth out of three was replanted indicating the lack of knowledge among parents and caregivers for the importance of urgent and proper management of traumatized teeth (Al-Jundi, 2006).

Fourty two percent of children with untreated TDIs needed acid etch restoration only since most injuries are without pulp involvement. This resembles the results of Lviny et al. (2010) and Traebert, et al. (2006). Most cases with pulp involvement needed root canal treatment and bleaching emphasizing on the importance of timely and urgent treatment of traumatized teeth to avoid consequences that require more extensive and costly treatment such as pulp therapy, crowns, and bridges (Al-Jundi, 2002).

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5.3.4 Details of the injury event (when, where, and how)

Nearly half of children did not remember the details of the injury event since most TDIs occurred at least one year before examination. Most TDIs occurred in summer. This finding resembles the finding of Kargul et al. (2003) and shows that the active life style of children noticed in this season affected the prevalence of TDIs. Home was the most common place where injury occurred followed by street. These results are similar to those recorded by Traebert et al. (2003) and Noori and Al-Obaidi (2009) and in agreement with other studies where home was the most frequent place for occurrence of TDIs (David, et al., 2009, Soriano, et al., 2007). This emphasizes on the need for the use of safety measures at home and the role of preventive strategies in providing environments that are favorable to health (Soriano, et al., 2007).

In agreement with other studies (Glendor, 2008, Rajab, 2003), falls and collisions were the most common cause of injury. However, a clear universal system to classify causes of injury is still lacking. For example; violence can be misinterpreted as collision, and it is difficult to classify falls during playing sports under falls, sports, or as a result of collisions (Al-Jundi, 2002)..

5.3.5 Gender and traumatic dental injuries

In the present survey males had more TDIs than females with a ratio of 1.4:1, two previous prevalence studies carried out in Jordan indicated a slightly higher ratio of 1.7:1 by (Hamdan and Rock, 1995), and 1.6:1 by (Hamdan and Rajab, 2003). Rajab

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(2003) reported male: female ratio of 1.8:1 among children presenting for pediatric dental clinic due to TDI in Jordan.

Although gender is a well known risk factor in most studies (Glendor, 2008), some authors reported almost similar occurrence of trauma among males and females, the ratio reported in Syria was 1.1:1 (Marcenes et al., 1999), and that reported in a more recent study in Turkey was 1:1 (Altun et al., 2009). Only one study carried out in Jordan demonstrated no significant differences between males and females (Al-Khateeb, et al., 2005).

Cultural reasons within the community may explain why males suffer more TDIs than females. The conservative nature makes females in Jordan less exposed to vigorous outdoor activities (Al-Jundi, 2002, Rajab, 2003). Males are more engaged in contact sports, entertainment games, or fights of a generally more aggressive nature or with a greater risk taking behavior than females do (Soriano et al., 2007).

Nevertheless; the lower male: female ratio observed in this survey may indicate that boys are more engaged in indoor activities with less aggressive nature and more participation in sports is expected among girls.

5.3.6 Socioeconomic indicators and traumatic dental injuries

Neither parents' level of education nor family income was significantly associated with the occurrence of TDIs. This was in agreement with most previous studies (Bendo, 2009, Marcenes, et al., 2000, Nicolau, et al., 2001).In this survey the prevalence of TDIs was 17.4 percent and 18.6 percent for children with high father's and mother's education

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level, respectively; compared with 16 percent in children with middle and low parent's educational level. Children from high parents' educational background might have greater ownership of leisure tools. However, in Jordan and other developing countries these devices might be used in unsafe environment. Family income was a vague indicator about socioeconomic status, since parents tend to have a subjective evaluation about their income and some prefer to be conservative.

5.3.7 Physical activity and traumatic dental injuries

TDIs were more frequent in children practicing sports regularly (17.6%), compared to less active children (14%). Nevertheless; the difference was not statistically significant. Studying the effect of favorite sport type on dental trauma occurrence shall not be representative since the types of sports are not equally distributed within the sample investigated. None of the children with physical evidence of TDIs was wearing a protective device on regular basis during any kind of physical activity. Only six subjects were using a mouthguard offered mostly from taekwondo clubs. Other studies are needed to evaluate the effect of mouthguards on the occurrence of TDIs.

5.3.8 Obesity and traumatic dental injuries

Histograms showing normal distribution of anthropometric measurements in the sample indicated good representation of the population investigated. However, a slight skewness of the curves was produced due to the presence of outliers. Large standard deviation among weight measurements showed how weight varied between

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schoolchildren in contrary to height measurements which were distributed with small standard deviation indicating minimal variation in children's heights which is expected in this age group.

Since there is no consensus in the literature to define weight categories in children and adolescents and there is no cut off points for the Jordanian population, the CDC-growth charts specific for age and sex were used to evaluate weight categories for 12-year-old Jordanian school children, and consequently obesity in the present study. This is an advantage that makes the results of this study comparable to other previous studies using the same methods. However, it might not give an accurate presentation of this medical condition since the life style of the Jordanian population and other developing countries is different from developed countries such as the United States.

Of the total 1015 children, 16.3 percent were overweight (14.7% of males and 17.9% of females) and 11 percent were obese (12.7% of males and 9.1% of females). The prevalence of overweight and obesity among the studied sample was higher than that reported in children from other Arab countries (Al-haddad, et al., 2000, El-Hazmi and Warsy, 2002). This leads into thinking that the results of this study are alarming. Compared to a recent study conducted by khader et al. (2009) in the north of Jordan among schoolchildren aged 6 to 12 years, 19.4 percent were overweight and 5.6 percent were obese, it seems that more overweight children are turning into obese ones in a short period of time indicating a major public health problem in this age group that needs further investigations to identify risk factors that predispose children to weight gain.

This study did not demonstrate a significant association between TDIs and obesity among 12-year-old schoolchildren in Jordan. This corroborates with the findings of

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Ărtun and Al-Azemi (2005) and Soriano et al. (2007). Two previous studies proposed the opposite. In Italy, Petti et al. (1997) claimed that obesity significantly affected the probability of dental injury. A study carried out in Brazil (Nicolau, et al., 2001) reported that overweight children were about two times more likely to have dental injuries than other children. However, different methodologies were used in these two studies. It was suggested that the lifestyle of obese children make them more prone to injuries due to lack of physical skills (Petti, et al., 1997). In our study, physical activities might be a trauma predisposing behavior rather than a protective factor. In Jordan like any developing country, children are engaged in different kinds of sports played in unsafe playgrounds without the use of mouth protection, thus even more skillful; the surrounding environment does not protect these children from the consequences of falls and collisions.

In the study sample; TDIs were most prevalent (20.0%) in underweight children compared to (10.7%) in obese ones. However, the difference was not statistically significant. It is assumed that physical activities might have helped children to obtain healthy weight ranges but at the same time may increase their proneness to TDIs because of the surrounding environment.

5.3.9 Predisposing factors and traumatic dental injuries

In agreement with the findings of Burden (1995), both inadequate lip coverage and increased overjet were significant associated factors for maxillary incisors trauma ($P<0.05$), with inadequate lip coverage the most important ($P<0.001$, OR=1.95). Increased overjet was a weak predictor for TDIs according to the multiple logistic

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regression analysis. It is assumed that soft tissue coverage from upper and lower lip acts as a protective factor from TDIs even in children with increased overjet. It is the inadequate lip coverage that predisposes children mostly to the traumatic sequel of falls and collisions on teeth.

In comparison with previous studies, orofacial characteristics were underestimated by some authors. Brin et al. (2000) reported that increased overjet and inadequate lip coverage of maxillary incisors were not fully capable of predicting the likelihood of TDIs. Moreover; Stoke et al. (1995) revealed that overjet was not positively correlated with TDI in Singapore schoolchildren. These results were in concordance with Marcenes et al. (2000); children with incisor overjet greater than 5 mm and inadequate lip coverage were not more likely to experience TDIs in Brazil.

However, it has been suggested in the literature that increased overjet was a consistent risk factor found in most studies to increase the risk for TDIs (Al-Khateeb, et al., 2005Borzabadi-Farahani, et al., 2010, Hamdan and Rajab, 2003). This conflict is explained by the fact that age, gender, and race-ethnicity are confounders to the incisal trauma-overjet relationship and must be adjusted for (Nguyen, et al., 1999, Shulman and Peterson, 2004). Furthermore; several studies did not investigate inadequate lip coverage as a risk factor for incisor trauma resulting in biased outcomes (Hamdan and Rock, 1995, Hamdan and Rajab, 2003).

In our survey, adjusting for gender and lip coverage, which were significantly associated factors with TDIs, revealed that overjet was not a strong predictor for TDIs occurrence as previously assumed. Lip coverage was the principal orofacial

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predisposing factor for TDIs; children with inadequate lip coverage were two times more likely to be affected than children with competent lips.

It is worthy to mention that overjet size recorded in the present survey measures only the horizontal distance between upper and lower central incisors. Overjet size does not give an accurate indication about proclination of maxillary central incisors. Small recordings of overjet might be the result of compensatory mandibular incisors proclination, resulting in false interpretation of maxillary incisors protrusion. Further investigations are needed to assess maxillary incisors protrusion through cephalometric radiographs, to uncover if the inclination of maxillary incisor teeth rather than the overjet size contributes to the occurrence of TDIs.

It must be borne in mind that this is a cross-sectional study that can be used to explore associations, not causation.

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5.4 Limitations

An important methodological argument of the present study is that obesity was not investigated at the time of injury. Most children suffered a TDI's experience at least one year before the examination, making the interpretation of data about the association of TDIs and obesity less representative. Other hospital-based studies are needed where anthropometric measurements are assessed at the time of injury.

The possibility that BMI has failed to distinguish between fat and fat-free mass (muscle and bone) may present another shortcoming of the study suggesting that the index could exaggerate obesity in large and muscular boys. Moreover; growth charts specific for the Jordanian population are needed.

Nearly half of the children did not recall details about the injury event, highlighting on the importance of parents' involvement through questionnaires in future surveys which at the same time increases the awareness about TDIs.

For cultural reasons, the terms "enough", less than enough", and "more than enough" were used to report family income making parents' answers vague and subjective.

During school visits, it was noticed that the type of school was not a good indicator about the socioeconomic status since some private schools especially in unprivileged areas presented with poor quality of hygiene measures comparing to other public and UNRWA schools in the same area. Finding an accurate operational definition of socioeconomic status is still a major problem in most studies and within the Jordanian population.

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Another limitation of this study that is found in most epidemiological surveys is the lack of diagnostic aids such as radiographs; root fractures and luxation injuries were overlooked making the prevalence of TDIs underestimated.

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Chapter Six: Conclusions and Recommendations

6.1 Conclusions

The results of this epidemiological survey show that:

- There is no significant association between TDIs and obesity among 12-year-old schoolchildren living in Amman-the capital of Jordan.
- Traumatic dental injuries are common among the studied population with a prevalence of 16.3 percent.
- TDI is a neglected oral condition since the majority of traumatized teeth remain untreated; low priority of dental health is noticed among the studied population.
- The relationship between TDIs and socioeconomic indicators was not statistically significant.
- Gender predilection was evident with males 1.4 times more affected than females.
- Being a male with incompetent lips has significantly increased the risk for TDIs.
- Inadequate lip coverage is the principal orofacial risk factor for TDIs.
- Prevalence of overweight and obesity among 12-year-old Jordanian schoolchildren living in Amman were high compared to neighboring countries.
- Since the sample selection was random, the results of the present survey can be generalized on the studied population.

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6.2 Recommendations

While TDIs are mostly limited to enamel that seldom need treatment, they are still widespread with serious and costly consequences that make preventive strategies of great value. Based on the results of the present survey, the following are recommended:

- Public health promotion programs targeted at populations and high risk groups are highly recommended to reduce the prevalence of TDIs and obesity among children.

- Education programs through school health services may play a major role in increasing awareness of children, teachers, and caregivers on the importance of TDIs prevention and timely management.

- This study can help policy makers to provide adequate preventive measures such as safe playgrounds and well-equipped environment especially in rural areas.

- Early orthodontic treatment is recommended to correct overjet and modify facial profile.

- As childhood obesity is becoming more prevalent, intervention strategies are needed to increase children physical activities.

- Preventive strategies should be directed at schools, as they are the institutions with greatest influence on children in conjunction with parents

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Appendix I : Age- and sex-specific growth charts adopted by Centers for Disease Control and Prevention

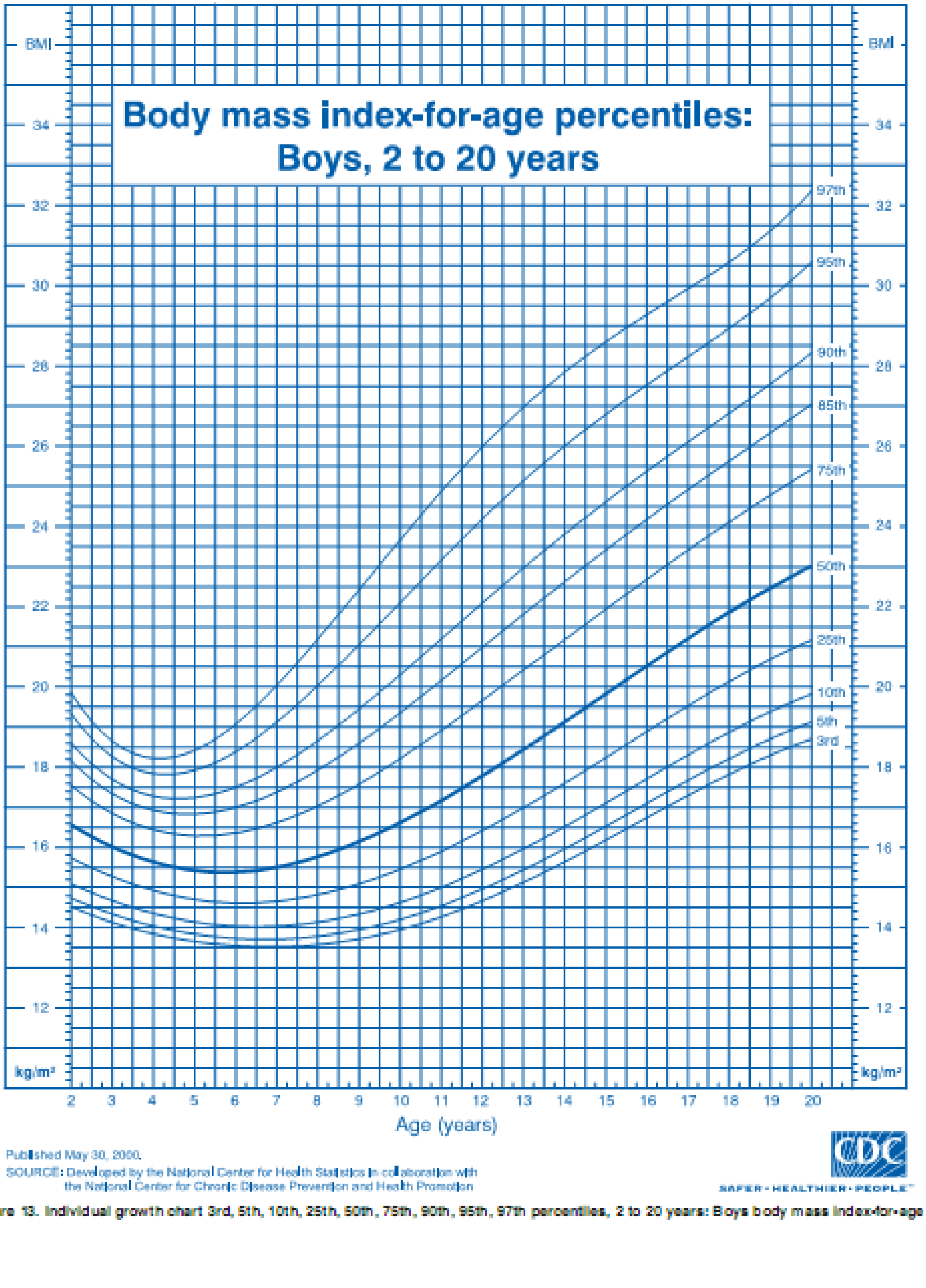


Figure 13. Individual growth chart 3rd, 5th, 10th, 25th, 50th, 75th, 90th, 95th, 97th percentiles, 2 to 20 years: Boys body mass index-for-age

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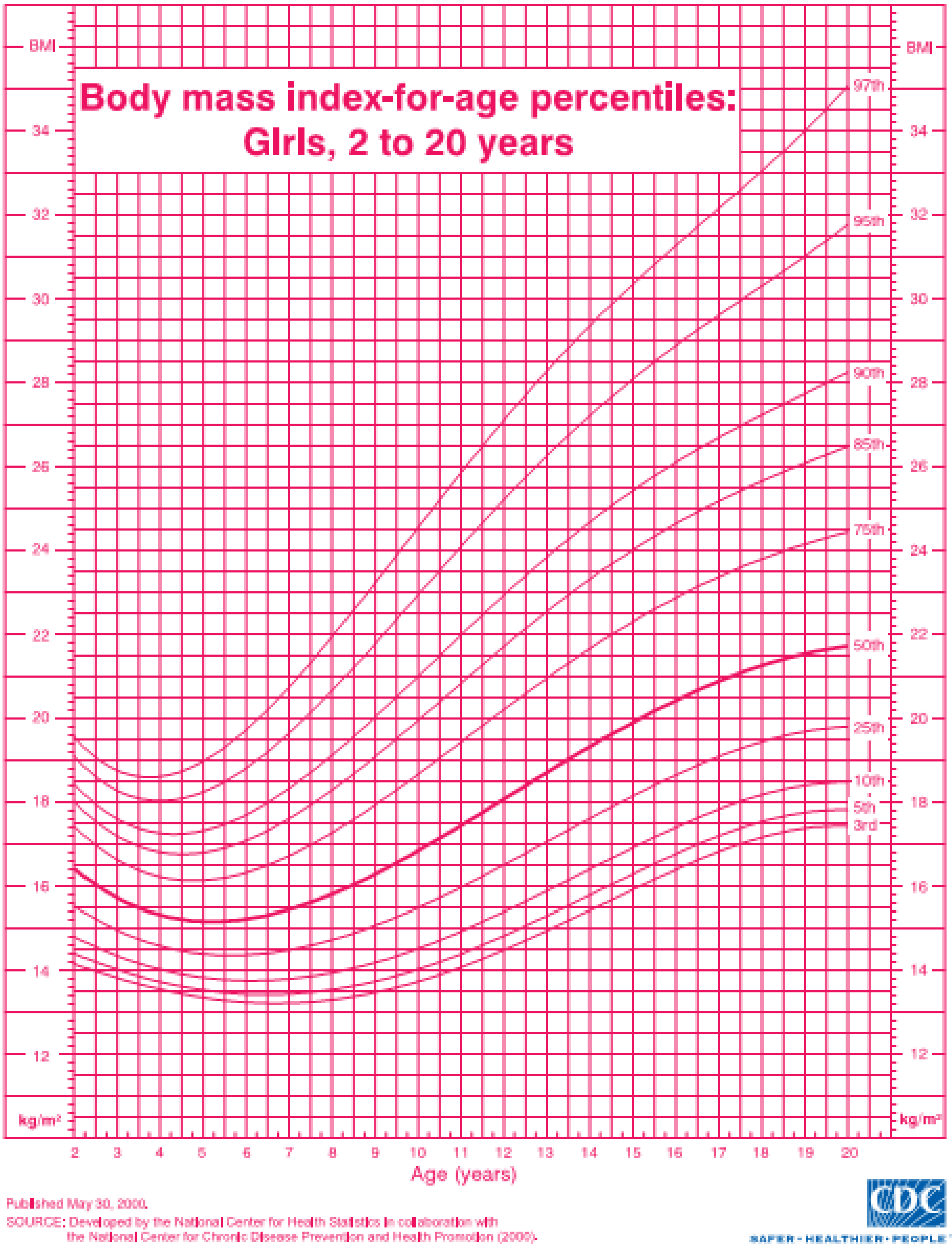


Figure 14. Individual growth chart 3rd, 5th, 10th, 25th, 50th, 75th, 85th, 90th, 95th, 97th percentiles, 2 to 20 years: Girls body mass index-for-age

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Appendix II: IRB form

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Appendix III: Parents' consent form

أعزاؤنا أولياء أمور الطلبة

تحية طيبة و بعد...

تحت إشراف الطبيبة تالا طارق البجالي–طالبة ماجستير طب أسنان أطفال/الجامعة الأردنية, أرجو التكرم بالموافقة على مشاركة أبنائكم بإجراء بحث يتضمن دراسة كسور الأسنان الدائمة الأمامية و السمنة لدى طلاب المدارس للفئة العمرية ١٢ سنة.

يتطلب البحث فحص فم وأسنان ,وقياس وزن و طول لطلبة الصف السادس الأساسي.

دراسة كسور الأسنان الدائمة الأمامية والأسباب المؤدية إليها تساعد الجهات المعنية على إنشاء برامج للوقاية من أثارها السلبية على الأطفال,و تفادي تكلفة علاجها.

جهودنا تثمر بتعاونكم, علما بان كامل المعلومات سوف تعامل بسرية تامة.

واقبلوا فائق الاحترام

□ أوافق □لا أوافق

توقيع ولي الأمر:______

في حالة الموافقة,أرجو إملاء البيانات التالية:

المستوى التعليمي للأب:

□ أقل من توجيهي □ توجيهي □ دبلوم □ بكالوريوس □ ماجستير

□ دكتوراة

المستوى التعليمي للأم:

□ أقل من توجيهي □ توجيهي □ دبلوم □ بكالوريوس □ ماجستير □ دكتوراة

هل تعتبر دخل الأسرة:

□ كافي □ غير كافٍ □ فائض في الدخل

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Appendix IV: The list of randomly selected schools and the number of students assigned to participate in the study.

المدارس الخاصة في عمان

مدارس الذكور	**طلاب الصف السادس**	**الطلبة المشاركين**	
المنهل	29	24	
الكلية العلمية الإسلامية	80	34	
أكادمية الرواد الدولية	99	42	
مدرسة القديس دي لاسال الفرير	72	23	
مدارس الإناث			
المدرسة الأهلية للبنات	80	20	
الكلية العلمية الإسلا مية	58	16	
النظم الحديثة الأولى	69	8	
المدارس المختلطة		♀	♂
اكاديمية المجد الوطنية	69	20	6
مدارس التألق العالمية	71	8	11
الكلية المعمدانية	77	15	11
مدرسة رواد الإسلام	15	8	4
المجموع		250	

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المدارس الحكومية في عمان

مدارس الذكور	طلاب الصف السادس	الطلبة المشاركين
مدرسة يعقوب بن هاشم	59	11
مدرسة المهلب بن أبي صفرة	120	67
مدرسة حسبان الثانوية للبنين	48	35
مدرسة القويسمة الأساسية للبنين	171	42
مدارس الإناث		
مدرسة ضاحية الرشيد الثانوية الشاملة للبنات	72	27
مدرسة الخنساء الثانوية الشاملة للبنات	88	77
مدرسة الجندويل الشاملة للبنات	78	34
المدارس المختلطة		♀ ♂
مدرسة حسبان الأساسية المختلطة	48	27 -
مدرسة صفية بنت عبد المطلب	72	40 -
المجموع		360

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مدارس وكالة الغوث في عمان

مدارس الذكور	طلاب الصف السادس	الطلبة المشاركين
ذكور صويلح الإعدادية	76	44
ذكور وادي السير الإعدادية	80	36
ذكورالنزهة الإبتدائية الثانية	81	38
مدارس الإناث		
اناث الجوفة الإبتدائىة	102	51
المدارس المختلطة		♀ ♂
مدرسة مخيم الحسين الأساسية المختلطة	74	36 -
المجموع		205

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مدارس البادية الوسطى

مدارس الذكور	طلاب الصف السادس	الطلبة المشاركين	
مدرسة ام قصير الثانوية الشاملة للبنين	35	30	
مدرسة الجيزة الثانوية الشاملة للبنين	30	25	
مدرسة منجا الثانوية الشاملة للبنين	33	17	
مدارس الإناث			
مدرسة أم الوليد الثانوية الشاملة للبنات	20	17	
مدرسة أم قصير الأساسية للبنات	36	33	
مدرسة أم العمد الثانوية الشاملة للبنات	25	12	
المدارس المختلطة		♀	♂
مدرسة نتل الأساسية المختلطة	13	-	10
مدرسة أم رمانة الأساسية المختلطة	14	7	6
مدرسة الجيزة الثانوية الشاملة المختلطة	38	33	-
مدرسة جلول الثانوية المختلطة	6	-	2
المجموع		192	

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Appendix V:

THE UNIVERSITY OF JORDAN

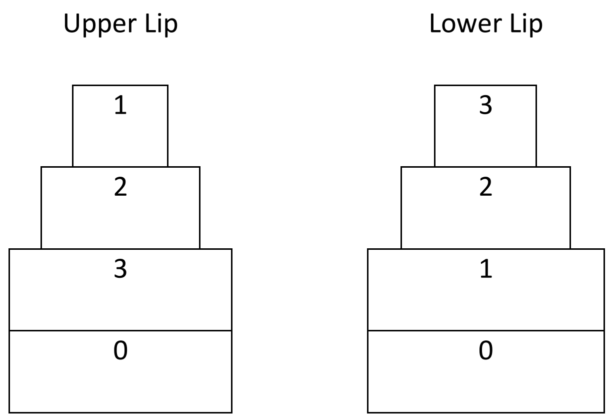
"SURVEY EXAMINATION FORM"

School Code:
Student Code:
Gender: □ Male □ Female

Medical History: ________________________________
Physical Activity:
Do you play sports regularly? □ Yes □ No
Which is your favorite?
○Football ○Basketball ○Handball ○Swimming ○Kickboxing
○Taekwondo ○Horseback riding ○Bicycle ○Tennis ○Running ○others
***Do you use a mouthguard during contact sports? □ Yes □ No**

Examination:
Physical Examination:
Weight: ____kg Height: _____cm

Dental Examination:
Overjet: _____mm
Lip coverage: □Yes □No
Lip coverage to upper incisors:



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***Traumatic Dental Injuries** (Write the code on the boxes)*

(0) No sign of injury
(1) Treated injury (Please, fill level 2)
(2) Enamel fracture only (Please, fill level 3)
(3) Enamel/Dentin fracture (Please, fill level 3)
(4) Pulp involvement (exposure, discoloration, swelling, sinus tract) (Please, fill level 3)
(5) Missing teeth due to trauma (Please, fill level 3)
(6) Other damage (Please, specify and fill level 3)

UR2	UR1	UL1	UL2
LR2	LR1	LL1	LL2

***Level three: Treatment needed** (Write the code on the boxes)*

(0) No treatment needed
(1) Acid etch restoration only
(2) Acid etch restoration and root canal treatment
(3) Acid etch restoration and root canal treatment and bleaching
(4) Permanent crown only
(5) Permanent crown and root canal treatment
(6) Denture
(7) Other treatment (specify)

UR2	UR1	UL1	UL2
LR2	LR1	LL1	LL2

***Level three: Treatment needed** (Write the code on the boxes)*

(0) No treatment needed
(1) Acid etch restoration only
(2) Acid etch restoration and root canal treatment
(3) Acid etch restoration and root canal treatment and bleaching
(4) Permanent crown only
(5) Permanent crown and root canal treatment
(6) Denture
(7) Other treatment (specify)

UR2	UR1	UL1	UL2
LR2	LR1	LL1	LL2

Date of injury: ___________________

When injury occurred:

□Spring □Summer □Winter □Autumn □Can't recall

Where injury occurred:

□Home □School □Street □Playground □Can't recall

How injury occurred:

□ Fall
□Collision
□ Sports:
○Football ○Basketball ○Handball ○Swimming ○Kickboxing
○Taekwondo ○Horseback riding ○Bicycle ○Tennis ○Running ○others
□ Traffic accidents
□ Inappropriate use of teeth
□ Biting hard items
□ Presence of illness, physical limitations, learning difficulties
□ Physical abuse
□Can't recall

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الإصابات السنية و البدانة لدى طلاب المدارس

للفئة العمرية 12 سنة

إعداد

تالا طارق البجالي

المشرف

الأستاذ الدكتورة لميس درويش رجب

الملخص

تعتبر الإصابات السنية ظاهرة غير متوقعة تحدث بشكل متكرر خصوصا عند الأطفال. إنَّ عواقبها على المدى البعيد و تكلفة علاجها إضافة إلى تأثيرها على الناحية الجمالية والوظيفية, والنطق جعلت من الإصابات السنية مشكلة عامة في غاية الأهمية.

تهدف هذه الدراسة الى تقدير نسبة الإصابات للأسنان الدائمة الأمامية لدى طلبة المدارس للفئة العمرية 12 سنة في الاردن، وتحديد العوامل المرتبطة بها، وكذلك دراسة احتمالية وجود علاقة بين إصابات الأسنان الأمامية و البدانة.

هذه الدراسة هي دراسة مسحية شملت مقابلة وفحص 1025 طالب من 34 مدرسة في المناطق المدنية و الريفية من عمان - عاصمة الأردن. حيث تم إختيار العينة بشكل عشوائي على مرحلتين. تمت دراسة نسبة كسور الأسنان الدائمة الأمامية بالنسبة للجنس, العوامل الإجتماعية والإقتصادية, نوع الإصابة و علاجها و تفاصيل حدوثها إضافة إلى بروز الأسنان و تغطية الشفة (العلوية) لها. لدراسة إحتمالية وجود علاقة بين كسور الأسنان الأمامية و البدانة تم تعريف زيادة الوزن و البدانة باستخدام معايير عالمية لمقياس كتلة الجسم خاصة بالعمر و الجنس.

أظهرت الدراسة أن نسبة الكسور السنية هي 16.3 %، إن أكبر نسبة للكسور كانت لكسورطبقة المينا (65%)، تليها كسورطبقتي المينا والعاج معاً (20 %)، وجد أن 6.4 % من الأسنان المصابة فقط تلقت معالجة. كسور القواطع المركزية العلوية تمثل النسبة العظمى إلى باقي الأسنان الدائمة الأمامية (92.7 %)، كما وجد ان نسبة الكسور عند الذكور أعلى من الإناث بمعدَّل 1.4 .

نسبة كسور الأسنان الأمامية لدى الأطفال مرتفعة في الأردن مقارنة في البلدان الأخرى، وهناك إهمال في معالجتها. تحدث كسور الأسنان الأمامية نتيجة التفاعل بين العوامل المرتبطة بها

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وأسلوب حياة الأطفال مع البيئة المحيطة بهم. لقد كانت إحتمالية حدوث الإصابات السنية أكبر عند الذكور الذين لهم تغطية الشفة للقواطع المركزية العلوية غير كافية. كما بينت الدراسة أنَّ البدانة ليس لها تأثير ذي أهمية على حدوث الإصابات السنية, حيث وجد أنَّ الأطفال قليلي الوزن هم الأكثر تعرضا للإصابات السنية. من المعروف أنَّ النشاطات البدنية تساعد الأطفال على تخفيف الوزن لكنها قد تزيد من إحتمالية تعرضهم للإصابات السنية.

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